

Current Science



Vol. 28, No. 10

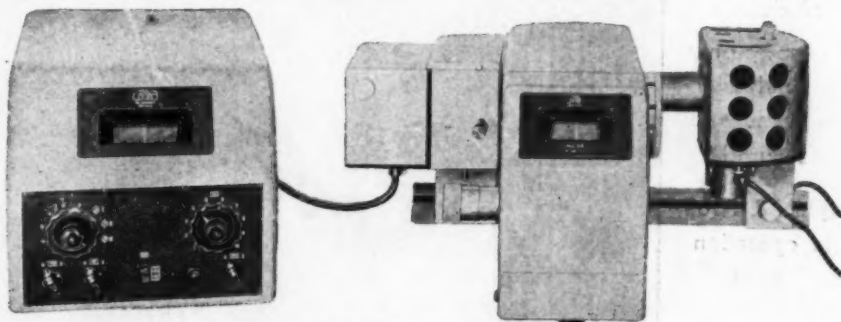
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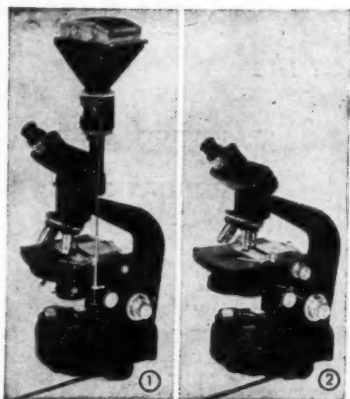
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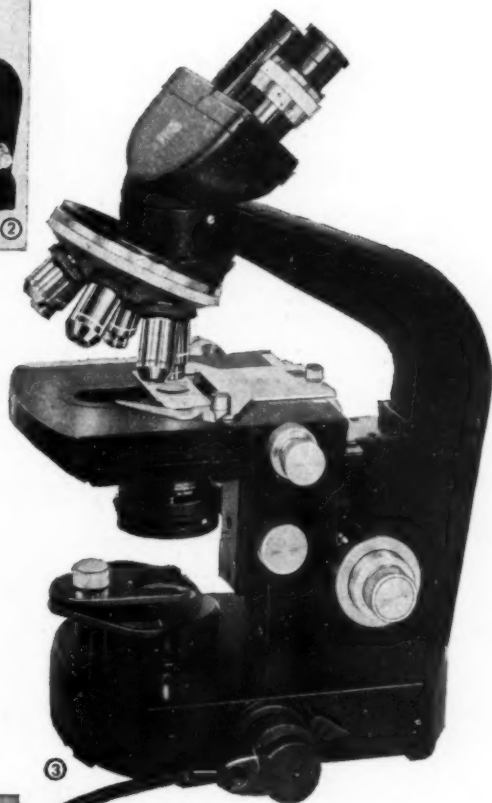
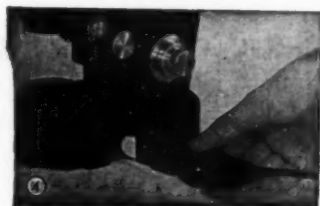


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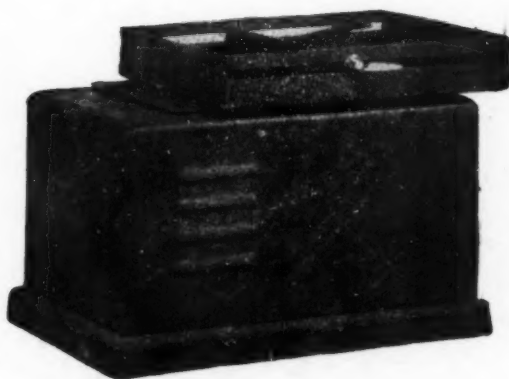
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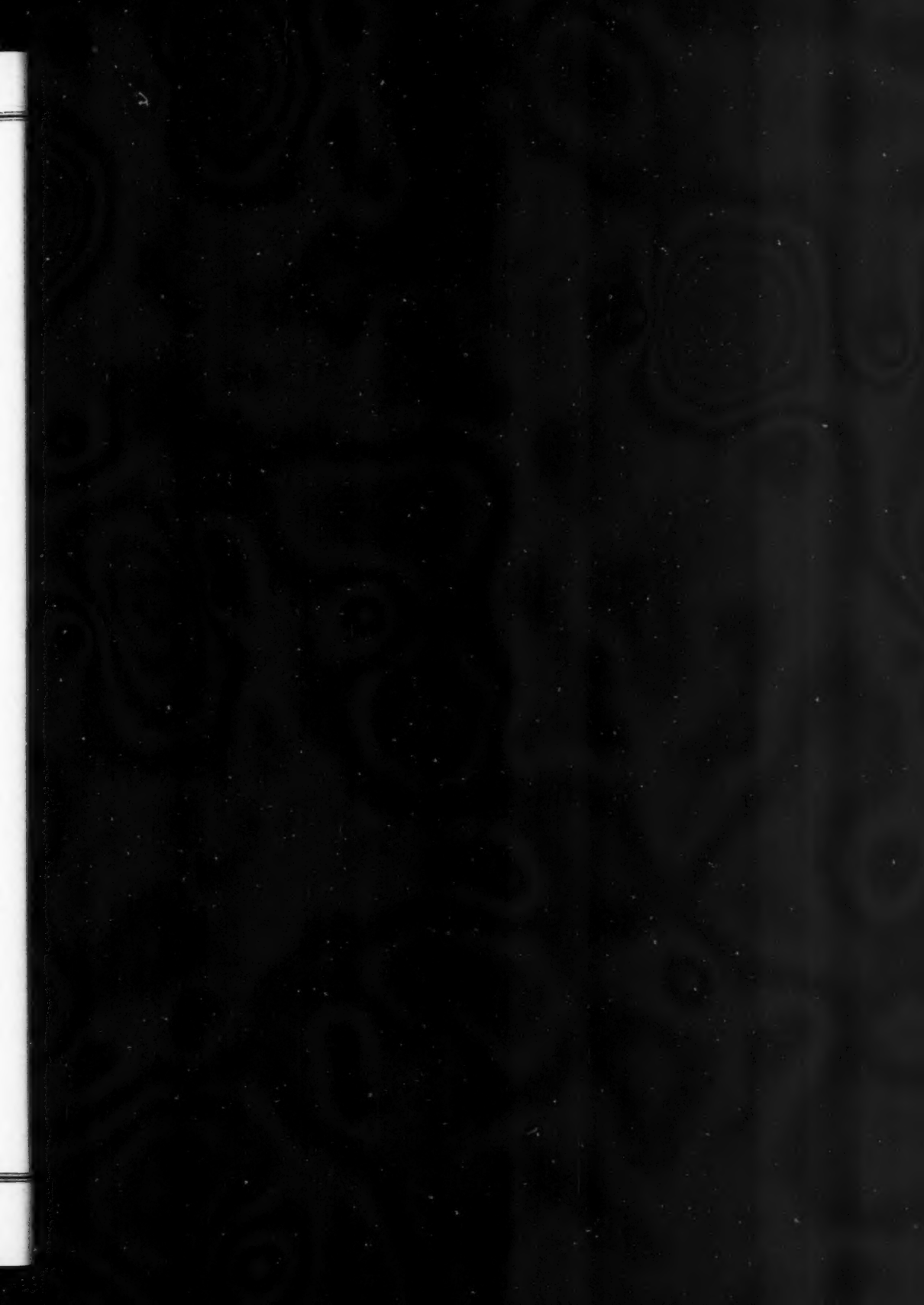
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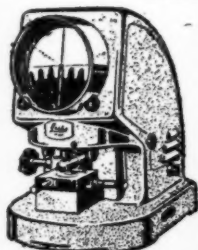
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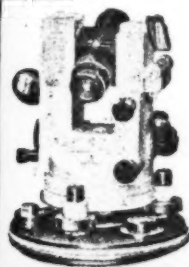


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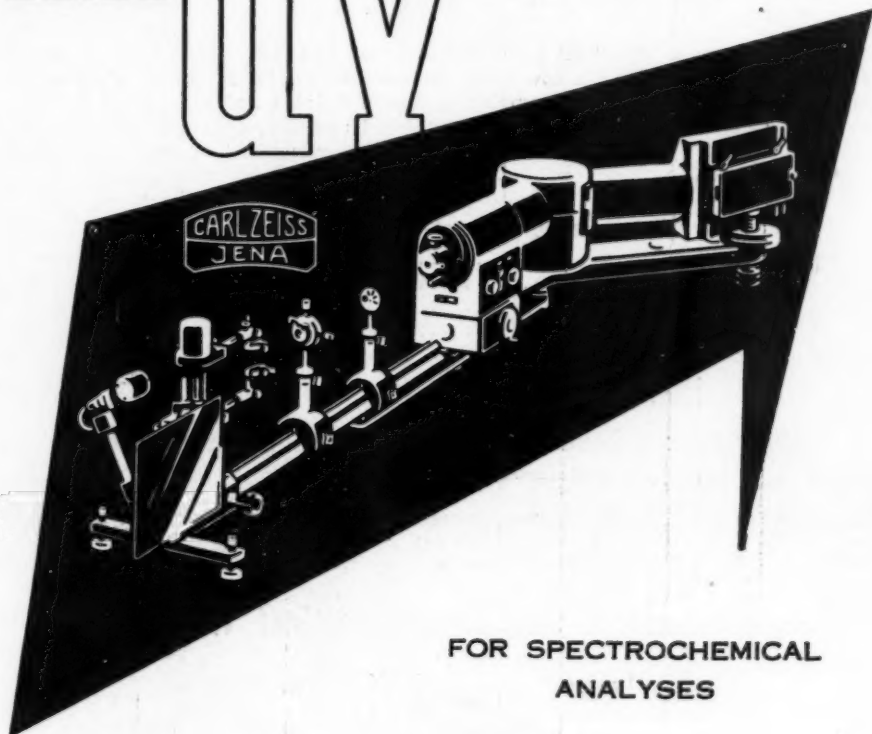
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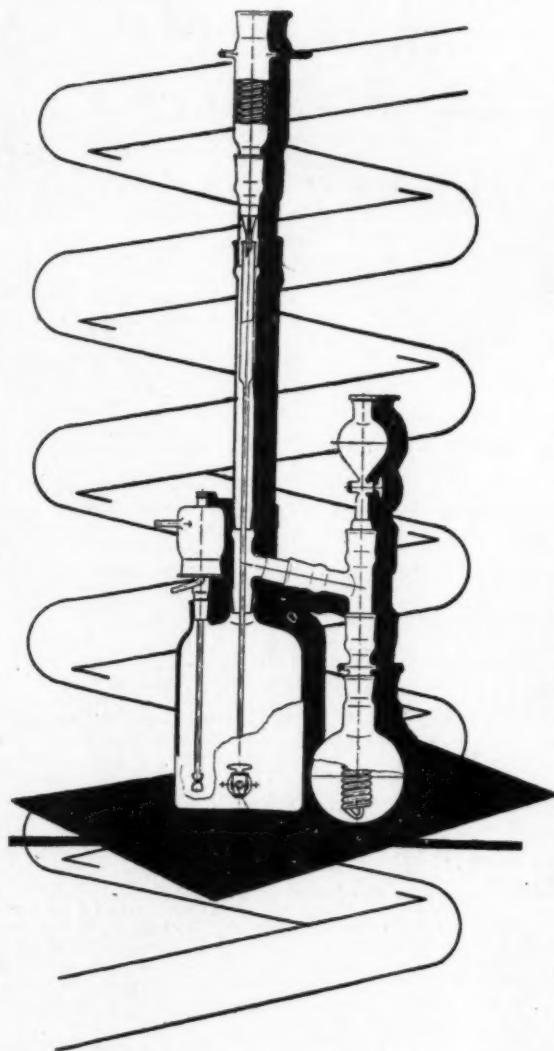
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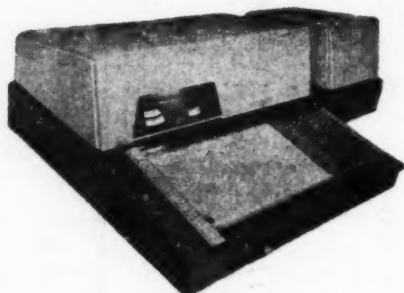
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INTERNATIONAL CONFERENCE ON COSMIC RAY PHYSICS (MOSCOW, 1959)

THE biennial Cosmic Ray Conference organised by the International Union of Pure and Applied Physics was held in Moscow from 6th to 11th July, 1959; this was the first time that this Conference was held in the U.S.S.R. About 250 scientists from 25 countries including India participated; out of this about 175 were from the U.S.S.R. A total of about 175 original papers were presented under the following heads:

(i) Nuclear interactions at high energies. (ii) Extensive air showers. (iii) Experiments on the primary radiation using balloons, rockets and satellites. (iv) Cosmic ray intensity variations. (v) Origin of cosmic rays and related astrophysical aspects.

Plenary sessions were held in the mornings, at which the more important papers and papers covering the overall work of large groups were presented. In the afternoons two parallel sessions were usually held, where results of a more detailed nature were reported and discussed.

(i) Nuclear Interactions at High Energies:

It is clear that, for a very long time to come, nuclear interactions above 100 BeV will be studied by cosmic ray experiments alone. In order to investigate these, the so-called jets, with photographic emulsions, it is necessary to expose large stacks at high altitude for long periods of time; this is because the very high energy particles are extremely rare in the cosmic radiation. The cost of such a stack is enormous; for example, a stack one metre square and one mean free path deep costs about 15 lakhs of rupees. A further difficulty is the location of these jets. These difficulties are removed to a large extent through the use of "emulsion chambers" which are made up of layers of emulsion interleaved with thin plates of elements of high atomic weight, such as lead and tungsten. Such an assembly is not only very much cheaper than a similar stack of emulsion but also allows easy location of the jets by visual examination of the emulsions close to the lead or tungsten plates for high density electro-magnetic cascades. Such assemblies have been used on a small scale in the past; but recently the Japanese Co-operative emulsion group (Fujimoto, Nishimura and others) and the Bristol emulsion group (Fowler, Perkins and others) have used them on a large scale. The Bristol group have exposed an assembly of 1 cu. ft. in volume for 1,200 hours on high flying Comet aircraft. From a study of electro-magnetic cascades they find that the integral energy spectrum,

$N(>E) \propto 1/E^n$, for γ -ray energies between 10^{12} - 10^{13} ev. has an exponent $n = 3.5$; a similar exponent is found for γ -rays of similar energy arising from the decay of π^0 -mesons produced in nuclear interactions in the emulsion. The value of n for the primary radiation is known to be about 1.7. This observation, if confirmed, could mean that there is either a sharp cut-off of the primary energy spectrum at an energy of about 10^{15} ev./nucleon, or that the energy going into pions at these high energies is greatly reduced; this latter conclusion, taken with other evidence, would indicate appreciable production of particles other than pions at these energies. The Japanese group, using a similar arrangement at mountain altitude, obtain for γ -rays of energy between 10^{11} and 10^{12} ev. an exponent of 2.0. There is thus an indication at this stage that there is something new occurring in the range of primary energies which contribute to the production of photons of energy between 10^{12} and 10^{13} ev. Experiments using such chambers will be carried out extensively in the near future at mountain, airplane and balloon altitudes; the very heavy weight of these assemblies, about a ton, and the long exposures, of the order of days, put a considerable strain on balloon techniques.

A serious difficulty in these investigations is that there is no way, at the moment, of estimating the energy of the primary particles. A conventional method has been to derive the primary energy from the angular distribution of secondary relativistic particles; the basic assumptions underlying these have been questioned. A Russian group (Grigorov and others) have set up an "Ionisation Calorimeter" consisting of alternate layers of lead (or iron) and some particle detector such as ionisation chambers and photographic emulsions. The primary particle interacts in a layer of graphite above this assembly and the secondary particles travel through the calorimeter, in which they produce further interactions and the various particles lose energy in ionisation process. The total depth of the ionisation calorimeter is sufficient to ensure that all the energy brought by the primary particle and distributed to the secondary particles is expended in it in the form of ionisation; this represents a direct estimation of the primary energy, and the accuracy obtainable is $\sim 30\%$. Preliminary results obtained with this arrangement were reported.

A review talk was given by Feinberg on the present status of our theoretical understanding of phenomena at these energies. A number of interesting papers were also reported on the

analysis of high energy interactions, particularly on the existence of asymmetries in the angular distribution of secondary particles in the centre of mass system and its bearing on the question of the number of centres in the C.M. system from which the secondary particles are emitted.

(ii) *Extensive Air Showers* :

Results on extensive air showers (EAS) were presented by the large groups working at Moscow, M.I.T., Cornell and Tokyo. The role played by fluctuations in the interpretation of EAS was one of the main topics of discussion at the Conference. Basically, there are three types of fluctuations : (a) the primary particle may be a proton or a heavier nucleus with charge from 2 up to 26 ; (b) the level of the first collision will show considerable fluctuation with respect to the top of the atmosphere and (c) the characteristics of the various collisions in the atmosphere—the number of pions produced, their angular distribution, the inelasticities involved, etc.—and their energy dependence can cause considerable fluctuations. The Japanese group was strongly of the view that cause (b) was the main source of fluctuations. Experimental results on the fluctuations of core structure, energy flow, lateral distribution of particles and on the longitudinal development of the shower (by observations on the Cerenkov radiation produced in the atmosphere at different altitudes) were presented by the Russian group and the results on the fluctuations in the muon component of EAS by the Japanese group. The M.I.T. and the Cornell groups reported evidence for the existence of showers containing as many as 10^9 to 10^{10} particles, as also the more recent data for the number spectrum, absorption mean free path, etc. One of the more interesting observations is that of multiple penetrating showers observed in cloud chambers at mountain altitudes, as also that of a number of bunches of parallel penetrating particles deep underground ; the mechanism responsible for the production of these is not yet clear.

(iii) *Experiments on the Primary Radiation Using Balloons, Rockets and Satellites* :

The most spectacular reports in this session relate to the existence of intense radiation zones surrounding the earth, the inner one extending from about 1,000 km. to 8,000 km. and the outer one from about 15,000 km. to 50,000 km. The properties of these zones, as derived from the limited number of observations made so far, are as follows :

(a) *The Inner Zone*.—The particles in the inner zone are electrons and protons. The

existence of protons in the zone is established by emulsion observations. The electrons are mainly of low energy ; experiments with a magnetic spectrometer show that, between 30 KeV. and 4 MeV., 99% have energies less than 600 KeV. The integral range spectrum of the radiation falls by two orders of magnitude from 1 mg./cm.² to about 140 mg./cm.²—these are mainly electrons—then trails out more gradually towards greater stopping power. Of the radiation which penetrates 140 mg./cm.² a fraction of 1% penetrates several grams per square centimetre. The inner zone is relatively stable as a function of time. Protons and electrons arising from the decay of albedo neutrons and trapped in the earth's magnetic field could be an important input to the inner zone. That this can be so was demonstrated by the Argus experiment in which small yield atomic devices were exploded at high altitudes and the β -decay electrons from the fission fragments observed in the inner zone. Whether the albedo particles can explain the features of the inner zone quantitatively is not yet known.

(b) *The Outer Zone*.—It is now fairly well established that the overwhelming majority (> 98%) of particles in the outer zone are electrons. The energy spectrum apparently resembles that of the auroral soft radiation—rising sharply towards low energies from a practical upper limit of about 100 KeV. Further, the spectrum in the central region is softer than at the fringes, the effective energies being 25 KeV. in the central region and 50 KeV. at the fringes. Measurements with Pioneer IV (of 3 March, 1959) showed that the maximum intensity was much greater at that time than that observed with Pioneer III (of 7 December, 1958) and extended some 15,000 km. further out. This large temporal fluctuation provides the most important evidence for the solar origin of, at least, the outer zone ; just prior to the Pioneer IV observations, there was a great M-region event on the sun (on February 25, 1959).

The interplanetary cosmic ray intensity has been estimated to be 0.18 ± 0.008 charged particles/cm.² sec. sterad. The photon intensity in the energy interval 45–450 KeV. is 3.0 ± 0.1 photons/cm.² sec. sterad ; this is still subject to doubt.

(iv) *Cosmic Ray Intensity Variations* :

New information regarding cosmic ray intensity variations comes from the large amount of work done at various laboratories in connection with the I.G.Y. The most striking observation that has been made in this field is the high degree of correlation that is found

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to exist between the cosmic ray intensity variations and solar flares, solar radio emission, radio fade outs and ionospheric disturbances, magnetic storms and auroral displays. This correlation has been established by the simultaneous observations on different geophysical phenomena during the I.G.Y. and since then. The time correlations observed are mostly interpreted in terms of solar corpuscular streams carrying frozen magnetic fields. The passage of the earth through these streams of ionized plasma and the consequent effects on the geomagnetic field at points away from the earth's surface is considered to be responsible for many of the observed effects.

An interesting observation by the Minnesota group might be mentioned here. They made a series of balloon ascents carrying photographic emulsions on receipt of information concerning enhanced solar activity (solar flare 3+ on 10th May, 1959). On the initial ascents the emulsions showed a normal background of tracks and then in a flight a few hours later the emulsions recorded an enormous intensity of low energy (50-500 MeV.) proton tracks. The visual difference between this and the emulsion

exposed a few hours before was spectacular. The presence of the low energy particles was interpreted in terms of the distortion of the Stormer cut-offs by the solar stream—the arrival of which also produced strong auroræ, solar noise and a magnetic storm.

(v) Theories of the Origin of Cosmic Radiation and Related Astrophysical Phenomena:

No new theories on the origin of cosmic radiation were presented. An interesting review of this subject, particularly on the theory of the supernovæ origin of cosmic radiation, was presented by Ginsburg. As a result of radio-astronomical observations carried out during the last two years a number of the parameters needed to elaborate this theory are much better measured and understood. This appears to be the only real theory at the moment which has a quantitative basis.

The next Conference of this type will be held in Japan in 1961.

Tata Institute of Fundamental Research,
Bombay-1.

R. R. DANIEL,
M. G. K. MENON,
B. V. SREEKANTAN.

IUTAM SYMPOSIUM ON THE 'THEORY OF THIN ELASTIC SHELLS'

A SYMPOSIUM on the theory of thin elastic shells, sponsored by the International Union of Theoretical and Applied Mechanics was held at Delft, Holland, under the Chairmanship of Prof. W. T. Koiter from August 24 to 28, 1959. Twenty-five invited research papers were read at the symposium.

Dr. C. B. Biezono, Honorary Chairman of the symposium, gave a resume of the work done in shell theory and pointed out avenues which still remain to be explored.

The symposium mostly dealt with non-linear and axially asymmetric problems. W. T. Koiter showed that the assumptions of a plane stress permitted scientific classification of all linear theories. He pointed out that Love's first approximation for the strain energy as the sum of stretching energy and bending energy gave a consistent first approximation, both in the linear and the non-linear theories.

W. Zerna gave results by taking into account a non-linear stress-strain relation of the form proposed by Kauderer, while B. R. Seth showed that, by using finite components of strain and the strained state as a reference framework, a thin cylindrical shell could be deformed into a conical one by applying normal surface loads. W. A. Nash showed that Berger's method of neglecting the second invariant of the strain

energy gave good results for finite amplitude oscillations of rectangular plates and deflections of spherical shells. P. M. Naghdi showed that the problem of shallow shells reduced to a system of coupled non-linear partial differential equations involving the axial displacement and a stress function. With some approximation they reduced to the systems obtained by Grigolyuk and Reissner. Buckling of shallow spherical and conical shells was extensively discussed by B. Budiansky, P. Seide, N. J. Hoff and J. Singer.

J. W. Cohen and E. Reissner dealt with helicoidal shells. Cohen showed that the classical stress-strain relations were insufficient and that the consequent inconsistency in the stress calculations could be removed by slightly altering the equations of equilibrium. E. Reissner took into account the effects of transverse stress and normal stress deformation and found that the state of stress in such a shell could be split into two parts—one of inextensional bending and the other of membrane or moment-free state.

The symposium left open the question of what would constitute a comprehensive theory of thin shells. Most of the approximations made in existing literature were shown to be inconsistent with the order of approximation permitted in the problem. B. R. SETH.

TAYLOR INSTABILITY AND THE DRIPPING OF LIQUIDS FROM HORIZONTAL SURFACES

E. S. RAJAGOPAL

Physics Department, Indian Institute of Science, Bangalore-12 (India)

IT was proved by Taylor¹ in a classic way that when the interface between two perfect incompressible fluids is accelerated, the interfacial disturbances are stable when the acceleration is directed from the denser to the lighter fluid and unstable when the acceleration is from the lighter fluid into the denser one. This Taylor instability has become important in understanding some of the phenomena associated with cavitation nuclei²⁻⁴ and with the hitherto unsolved problem of interfacial disruption in emulsification.⁵

Bellman and Pennington,⁶ while discussing the effect of viscosity and surface tension on Taylor instability, have shown that the dripping of liquids from flat surfaces is also beautifully explained. (The compressibility of air can be neglected in this approximation, as will be seen.) Considering, say, water in a vessel with air above it, the system is put in equilibrium by an upward acceleration (to counter the natural gravitational acceleration). Since this acceleration is from the denser to the lighter fluid, the surface is stable. Considering the inverted system, say water hanging to the underside of a plate, the conditions favour instability and it is a familiar observation that the disturbances grow in amplitude leading to the dripping of water. Bellman and Pennington made the calculations for plane wave disturbances and they suggested that the axial symmetry will alter the numerical values. The present note confirms this conjecture. It may be mentioned that this problem occurs in the author's theory of emulsification also.

Consider the horizontal interface between two fluids, the lower one of density ρ_2 and the upper one of density ρ_1 ($\rho_2 > \rho_1$). Using cylindrical co-ordinates with the origin on the interface and the z -axis upwards, the linearized axisymmetric equations governing the fluids are

$$u_r = -\frac{\partial \phi}{\partial r}; u_z = -\frac{\partial \phi}{\partial z}; \frac{1}{r} \frac{\partial}{\partial r} \left(r \frac{\partial \phi}{\partial r} \right) + \frac{\partial^2 \phi}{\partial z^2} = 0 \quad (1)$$

$$\frac{\partial u_r}{\partial t} + \frac{1}{\rho} \frac{\partial p}{\partial r} = 0; \frac{\partial u_z}{\partial t} + g + \frac{1}{\rho} \frac{\partial p}{\partial z} = 0 \quad (2)$$

$$p = p_0 - g\rho z + \rho \frac{\partial \phi}{\partial t} \quad (3)$$

where g is the net acceleration (from ρ_2 to ρ_1) normal to the interface.

In order to satisfy the equations of motion and the Laplacian, the solutions are to be taken as

$$\phi_1 = Ae^{-kz} f(t) J_0(kr);$$

$$p_1 = p_0 - g\rho_1 z + \rho_1 \frac{\partial \phi_1}{\partial t} \text{ in } \rho_1$$

$$\phi_2 = -Ae^{kz} f(t) J_0(kr);$$

$$p_2 = p_0 - g\rho_2 z + \rho_2 \frac{\partial \phi_2}{\partial t} \text{ in } \rho_2$$

It is seen that the ϕ 's give zero velocities far from the interface ($z = \pm \infty$ respectively) and also $u_1 = u_2$ at the (nearly plane) interface ($z \sim 0$). p is the mean pressure at the interface, the equation of which is $z = z(r, t)$ with axial symmetry.

Now at the interface

$$\frac{\partial \xi}{\partial t} = U_s = -\frac{\partial \phi}{\partial z} \Big|_{z=0} = kA f(t) J_0(kr)$$

and hence

$$\xi = kAJ_0(kr) \int_0^t f(t) dt.$$

The other condition at the interface is the equality of the pressures p_1 and p_2 , which yields after a differentiation

$$g(\rho_2 - \rho_1)kf(t) + (\rho_2 + \rho_1) \cdot \frac{d^2 f}{dt^2} = 0 \quad (5)$$

The solution can be taken as $f(t) = \sinh nt$, since it gives the state of rest ($u = 0$) at $t = 0$. If n is imaginary or negative, the interface is stable, while a positive value of n leads to an exponential increase of the amplitude of the disturbances with time (other types of singularities can be present in special cases^{7,8}). From equation (5) one gets

$$n^2 = \frac{-g(\rho_2 - \rho_1)k}{(\rho_2 + \rho_1)} \quad (6)$$

and so

$$\xi = kAn^{-1} J_0(kr) \cosh nt. \quad (7)$$

Instability sets in when g is negative, i.e., the acceleration is from the lighter to the heavier fluid.

The interfacial tension T can be easily incorporated by writing the pressure condition at the interface as $p_2 - p_1 + T(R_1^{-1} + R_2^{-1}) = 0$. The principal curvatures of the surface (of revolution) are easily found to be

$$-k^2 An^{-1} J_1(kr) \cosh nt$$

and

$$kAn^{-1} [kr^{-1} J_1(kr) - k^2 J_0(kr)] \cosh nt$$

and so in the place of equation (5) one has

$$g(\rho_2 - \rho_1)kn^{-1} + (\rho_2 + \rho_1)n + Tk^3 n^{-1} = 0$$

or

$$n^2 = \frac{[-g(\rho_2 - \rho_1)k - Tk^2]}{(\rho_2 + \rho_1)} \quad (8)$$

Equation (8) shows that even when g is negative, instability occurs only if

$$k < k_l = \left[\frac{-g(\rho_2 - \rho_1)}{T} \right]^{1/2} \quad (9)$$

(4) Also, n has a maximum, at which the amplitude grows fastest, when

$$k = k_m = \left[\frac{-g(\rho_2 - \rho_1)}{3T} \right]^{1/2} \quad (10)$$

The relations (6-10) are seen to be the same as those in the case of plane disturbances^{6,9} $f = \text{const.} (\cos. 2\pi x/\lambda) \cosh. nt$, except that k has replaced $2\pi/\lambda$. It appears probable that for arbitrary deformations of the interface, the conditions will be similar with suitable parameters replacing k .

Experiments on the dripping of water from the underside of glass plates show that dripping is a maximum when the "diameter" of the disturbance is ~ 1.5 - 2.0 cm., while no dripping occurs when this "diameter" is less than ~ 1.0 - 1.5 cm. (The amplitudes must be small. It can be shown^{10,5} that the spike of the heavier fluid will become narrower for larger amplitudes, in agreement with the familiar observa-

tions). The first root of $J_0(kr)$ occurs at $kr = 2.40$. So the limiting (lower limit) "radius" is $\sim 2.40 \times (70/980)^{1/2} \sim 0.6$ cm., while the most probable "radius" is $\sim 2.40 \times (3 \times 70/980)^{1/2} \sim 1.1$ cm. Of course, for detailed comparison, the exact mode of deformation must be observed and the theory must include the finite thickness of the liquid film.^{1,11} But the general physical situation is well understood now.

The author thanks Prof. R. S. Krishnan and Dr. V. S. Venkatasubramanian for their encouragement. He also thanks the C.S.I.R. for the award of a Senior Research Fellowship.

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LUNIK III—THE RUSSIAN THIRD MOON ROCKET

COINCIDING with the second anniversary of the launching of the first artificial earth satellite, Sputnik I, on October 4, 1957, Russia successfully launched her third cosmic rocket on October 4, 1959. The last stage of the rocket (weight, 1,553 kg. without fuel) on reaching the necessary speed, put into orbit an "automatic interplanetary station" which after circling the moon returned towards the earth and is now orbiting the earth.

The present moon flight is clearly a part of a well-defined programme of lunar interplanetary exploration and marks a considerable achievement in guidance and control techniques. Russia had previously launched two successful cosmic rockets; the first on January 2, 1959, which bypassed the moon and went into orbit round the sun (see *Curr. Sci.*, 1959, **28**, 47) and the second on September 12, 1959, which hit the moon (see *Curr. Sci.*, 1959, **28**, 359).

The placing of the automatic interplanetary station with the aid of a many-stage rocket, on a pre-selected trajectory has ensured its passage along a strictly defined course in relation to the moon, while at the same time ensuring its

maximum closeness to the moon. It thus became possible to make use of the moon's gravitational pull in such a way as to curve the further trajectory of the station's flight to ensure its return towards the earth over the northern hemisphere. The date for the flight around the moon was not selected without reason. On October 2-4 the moon was at the shortest distance from the earth, 363,000 km.

The "Station" itself weighs 278.5 kg. and is equipped with scientific instruments. The two transmitters working on 39.986 and 183.6 Mc./s. are powered by solar batteries. Information is being transmitted at definite intervals for about 2 hours a day, in conformity with the programme of observations. The operation of the equipment is being controlled from a co-ordination and computing centre on the earth.

It can be expected that Lunik III will yield much valuable scientific information on the nature of outer space, interplanetary matter, solar radiation and the nature of the Moon, especially the unseen side of it, which the "station" has photographed in its swing round the moon.

TRANSFORMATIONS OF 6-METHYLSALICYLIC ACID DERIVATIVES

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IN earlier publications^{1,2} relating to the biogenesis of lichen and mould products, it was indicated that a large number of these fall into the C_8 -unit (orsellinic unit) system. Attempts have also been made to derive them from acetic acid units.^{3,4} It has been shown that acetate as a nutrient in the growth medium could be utilized by moulds, and acetates may, therefore, play an important part in biogenesis. But, as a guide to the evolution of molecular architecture, the acetate hypothesis may not be so successful. The inherent difficulty is in the smallness of the unit as it is only next to the C_1 -unit. Larger units like C_5 , C_6 and C_8 provide definitely better indications. The contention of Robinson⁵ which is very significant in this connection may be quoted here. "There is no difficulty, for example, in adding atom to atom and thus arriving at any desired structure. In general the simple substances provide no useful comparisons, because the possibilities cannot be distinguished by inspection. On the other hand, the more complex molecules are much more revealing and a study of them soon leads to certain firm convictions. In this way a complex of interrelated ideas is formed and we can build on firmer ground." The significance of the C_8 -unit seems to be increasing because of newer discoveries. In our study of the C_8 -unit scheme, particular emphasis has been given to the gradual modifications that the C_8 -unit has undergone in various situations; these modifications involve reactions which can take place in the concerned structures with facility. In the present paper, the application of the C_8 -unit scheme of biogenesis is explained for the 6-methylsalicylic acid derivatives.

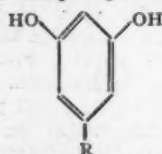
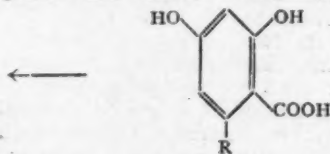
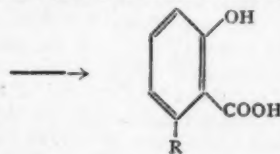
A. BENZENOID DERIVATIVES

(i) *Anacardic Acid Series*.—These constitute a group of natural products obtained from lacquer-producing plants and closely

related to 6-methylsalicylic acid (I). They are anacardic acid (II) (from *Anacardium occidentale*), ginkgolic acid (III) (from *Ginkgo biloba*) and pelandjaic acid (IV) (from *Pentaspadon* spp.).

The evolution of 6-methylsalicylic acid (I), a mould product, has already been discussed.^{2,6} It involves the loss of a hydroxyl group of the orsellinic acid (C_8 -) unit. The lengthening of the methyl side-chain in the 6-position of the C_8 -unit by addition of even number of carbon atoms was originally shown to be a common feature in lichen depsides and depsidones¹ and more recently recognized in the benzoquinone series.⁷ The above three acids (II, III & IV), which are chain-lengthened analogues of 6-methylsalicylic acid, should have a similar origin. This explanation of the biogenetic relationship receives support from the occurrence in the same sources of orcinol derivatives with lengthened side chains. They are cardol (V) (in *Anacardium occidentale*) and bilobol (VI) (in *Ginkgo biloba*). Orcinol (VII) itself has long been known as a lichen product (e.g., *Roccella montagnei*⁸), produced by facile decarboxylation of orsellinic acid (C_8 -unit, VIII). Cardol (V) and bilobol (VI) should be considered to be similar decarboxylation products of the corresponding carboxylic acids (IX & X). Thus from a common orsellinic acid type both the anacardic acid and the cardol groups of compounds can be derived.

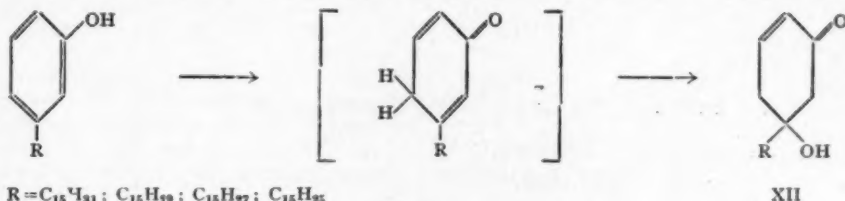
(ii) *m-Cresol Derivatives*.—Members of the cardanol series (XI a) (from *Anacardium occidentale*) and campnospermonol (XI b) (from *Campanosperma* spp.) are also related to 6-methylsalicylic acid analogues as decarboxylation products. The presence of the carbonyl group in the β -position of the side chain in campnospermonol (XI b) is what one meets

VII, R = CH₃V, R = C₁₅H₂₇VI, R = C₁₅H₂₉VIII, R = CH₃IX, R = C₁₅H₂₇X, R = C₁₅H₂₉I, R = CH₃II, R = C₁₅H₂₇III, R = C₁₅H₂₉IV, R = C₁₇H₃₁

with in the lichen acid series also (e.g., physodic acid).

Camptospermonol (XI b) is found to be accompanied by an optically active long chain compound⁹ (XII) which is a derivative of

are derivatives of catechol with long chains in the 3-position. It has been shown in the lichen acid series that a hydroxyl is frequently found in the same place as an aldehyde. A similar feature could be expected in the 6-

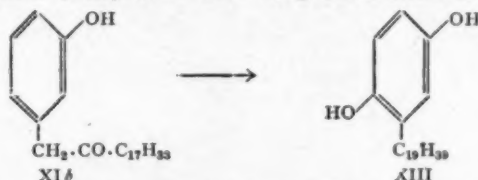


XI a, R = C₁₅H₃₁; C₁₅H₂₉; C₁₅H₂₇; C₁₅H₂₅

XI b, R = CH₂COC₁₇H₃₃

cyclohexenone. Their relationship is easy to discern. It is one of hydration and dehydration. But how hydration takes place in the aromatic unit is not clear and does not seem to have known biochemical analogies. A possible course of the reaction is indicated above.

(iii) **Quinol Derivatives.**—Another compound occurring along with camptospermonol (XI) is a long chain quinol (XIII) which has



recently been isolated from the oil of *Camptosperma auriculata*.¹⁰ Its relationship to camptospermonol (XI) is simple and its biogenesis should involve an extra step of *para*

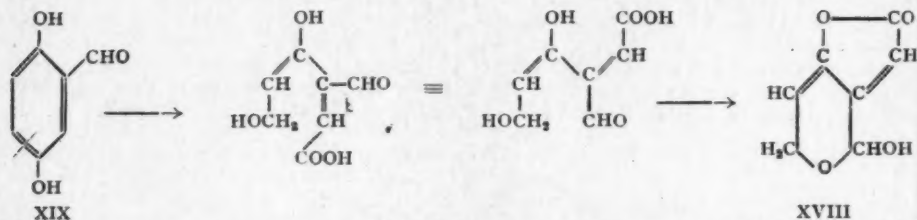
of mould products; hence in these cases the relationship to the original C₈-unit is not so obvious and has to be understood by careful scrutiny and analysis of the structures.



nuclear oxidation besides reduction of the side chain.

(iv) **Catechol Derivatives.**—There seems to be a group of compounds which are not directly related to 6-methylsalicylic acid but to the corresponding aldehyde as the C₈-unit. The members of the urushiol series (XIV) (from *Rhus* spp.), glutarenghol (XV) (from *Glutarenghas*) and laccol (XVI) (from *Rhus* spp.)

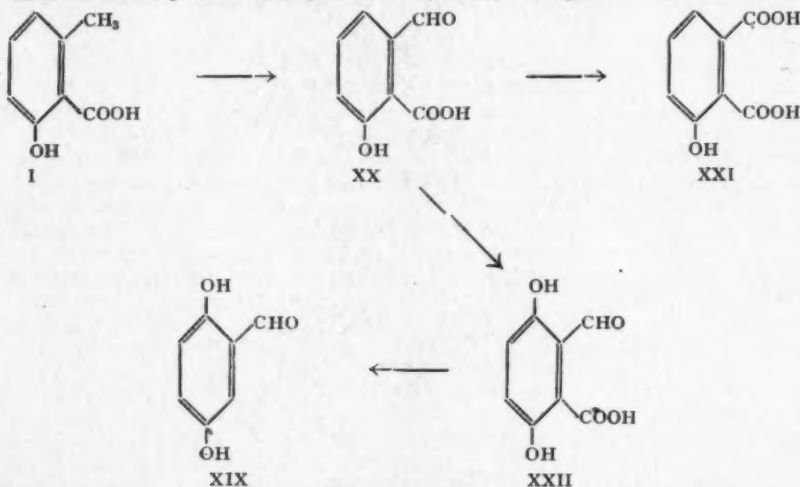
Patulin (XVIII) is an antibiotic substance of comparatively small dimensions and its constitution was finally established by Woodward and Singh.¹¹ Based on the co-occurrence of gentisyl alcohol, gentisic acid and patulin in the metabolic products of *Penicillium patulum*, Birkinshaw¹² suggested that gentisic aldehyde (XIX) was the precursor of patulin (XVIII). The stages involved are oxidative ring opening and



subsequent ring closure of the lactone and hemiacetal rings.

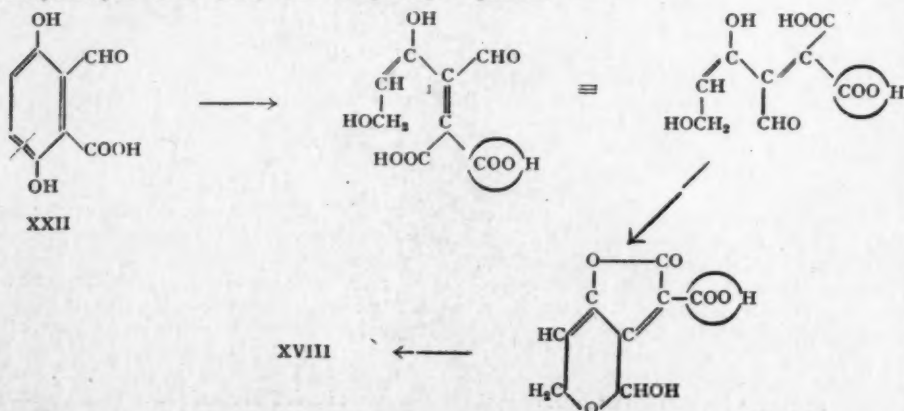
Later, Ehrensward¹³ isolated 6-methylsalicylic acid (I) as a metabolic product of *P. patulum*.

phthalic acid (XXI) as additional products from *P. patulum* besides the earlier reported substances. They suggested that the intermediate (XXII), though not so far isolated as



However, he felt that it was not directly related to patulin but was the product of a side reaction. Recently, Bassett and Tanenbaum¹⁴ have obtained gentisic aldehyde (XIX), 6-formylsalicylic acid (XX) and 3-hydroxy-

patulin, would explain the direct biogenetic relationship between 6-methylsalicylic acid (I) and gentisic aldehyde (XIX) which has been suggested to be the precursor of patulin.¹²



The above suggestion is supported by the work of Bu'Lock and Ryan¹⁵ who used labelled 6-methylsalicylic acid¹⁶ as a nutrient of *P. patulum* and isolated labelled patulin with the activity in the expected positions according to the above scheme of biogenesis. However, it is possible that patulin (XVIII) could be derived from the intermediate (XXII) itself as follows instead of passing through the gentisic aldehyde (XIX) as a further intermediate; the decarboxylation may take place at an undetermined stage.

SUMMARY

Members of the anacardic acid series and the accompanying orcinol derivatives are derived from orsellinic acids (C_8 -compounds) with lengthened side chains. *m*-Cresol derivatives are related to the anacardic acid series by a stage of decarboxylation and quinol derivatives by an extra stage of nuclear oxidation. Hydration of *m*-cresols also seems to be possible. Catechol derivatives with long side chains are derived from the corresponding aldehydes involving a stage of oxidation. Patulin is a typical example of a product obtained by ring fission from 6-methylsalicylic acid.

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* The following are recent additions to natural benzoquinones and related compounds: (i) solanachromene (Rowland, R. L., *J. Amer. Chem. Soc.*, 1958, 80, 6130); (ii) the corresponding plant quinone (Kofler, M., *et al.*, *Helv. Chim. Acta*, 1959, 42, 1283; Trenner, N. R., *et al.*, *J. Amer. Chem. Soc.*, 1959, 81, 2026) and (iii) abichromenol (Leidman, D. L., *et al.*, *Chem. and Ind.*, 1953, 1019).

NOBEL PRIZE IN MEDICINE

DR. SEVERO OCHOA and Dr. Kornberg, both of the United States, have been awarded the Nobel Prize in Medicine for 1959, for their discoveries of the mechanism in the biological synthesis of the Ribonucleic Acid and Deoxyribonucleic Acid.

The nucleic acids are present both in the nuclei and in the protoplasm of living cells and they are intimately connected with cell division, mutation and the manufacture of enzymes. The ribonucleic acid (RNA) takes part in the production of proteins whereas the deoxyribonucleic acid (DNA) is present in the chromosomes as carrier of the hereditary qualities.

Dr. Ochoa was born in Lluarca, Spain, in 1905 and qualified at Madrid University. In 1937

he worked in the Marine Biological Institute at Plymouth, England, and later was Nuffield Research Assistant in Biochemistry at the Oxford University Medical School. He came to the United States in 1940, and has been Professor of Biochemistry since 1954, at the New York College of Medicine. He has written a number of works on the biochemistry of muscles and of the brain.

Dr. Kornberg was born in 1918 in Brooklyn, New York, and received his M.D. at Rochester University. Until 1952 he was attached to the National Institute of Health, and later was Professor of Microbiology at the University of Washington. He is now Professor of Biochemistry at Stanford University, California.

INTERNATIONAL OCEANOGRAPHIC CONGRESS

THE First International Oceanographic Congress which drew over 1,100 scientists from some 45 nations ended its two-week session at United Nations Headquarters in New York, on September 12, 1959.

During the meeting plans for a major international research project in the Indian Ocean were announced by (International Council of Scientific Union) ICSU's Special Committee on Oceanic Research for the years 1960-64. This plan, somewhat on the model of the International Geophysical Year, provides for a thorough, co-ordinated study of the Indian Ocean by an international fleet of research vessels.

The Indian Ocean is of special scientific interest because twice a year the monsoons reverse its ocean currents and thus shift the locations of the up-swelling waters from below that are rich in the basic materials for the nutrition of fish. In addition, the ocean is thought to be crossed by a submerged mountain ridge that curves from below the tip of Africa to the Pacific, passing between Australia and Antarctica but branching to send a ridge also northward to the Red Sea.

Another project outlined during the Congress may help to answer questions on the age of the earth's crust and the original formation of the oceans. The proposal is to bore a hole all the way through the crust of the earth, where it is thinnest at the sea bottom, about 18,000 ft. below sea level, down to a depth of 31,000 ft. where the lighter crystal rocks and the earth's "mantle" begins.

A third important development was to call for a world-wide study of the radioactivity of the ocean waters to determine the effect of the submarine disposal of radio-waste products from nuclear reactors and the laboratories. A further recommendation was that the International Atomic Energy Agency in Vienna carry out a study of the maximum permissible concentration of oceanic radioactivity. There is no notable contamination of the ocean as yet, but the increasing number of nuclear power plants make these preparations advisable, in the opinion of the committee.

Among other topics—and there were many—that aroused special interest at the Congress are the following:

(i) The probability that life did not originate in the sea itself but on the under-water clay

surfaces in estuaries and shallow bays where "chemical evolution" took place for hundreds of millions of years at a time when the atmosphere was poor in oxygen but rich in hydrocarbons and perhaps ammonia. Increasingly complex organic molecules were formed by contact in concentrated layers absorbed in the clay until amino-acids resulted. These then combined to give proteins which were able to duplicate their own molecules. After that, organization of the proteins into cells became possible and biological evolution could begin. The oxygen in today's atmosphere would prevent such chemical evolution but the same process may well occur on the astronomical number of planets that may belong to stars other than the sun.

(ii) The earliest fossils found anywhere show that evolution must already have been going on for long periods of time without leaving a trace. The explanation of this is that the earliest animals were plant-eaters with soft bodies; it was the much later appearance of carnivorous animals that forced the protective development of shells and skeletons which form fossils.

(iii) The discovery that the relatively rich life in the ocean near the Equator, where the upward currents bring nutrients, resulted in the formation of a continuous band of sediments around the earth which indicates that the Equator has been where it is now for some 500 million years. Consequently the poles have not wandered about and some explanation is needed for glacial periods.

(iv) The indication that the chemical composition of the sea has not changed for some 250 million years, that the ocean has not become more salty and that therefore the salt in the ocean has not come from washing out the continents by rivers but must have some other, unknown origin.

(v) Sea plants and animals produce a wide variety of special chemical substances such as vitamins, antibiotics, growth stimulants and hormones which may themselves be valuable to man and which, with further study, could explain the occasional explosive growth of some varieties and also the catastrophic death of millions of tons of fish, apparently by disease, at some times and places.—UNESCO.

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LETTERS TO THE EDITOR

EFFECT OF CONVERSION OF MATTER INTO RADIATION ON THE CURVATURE OF AN EXPANDING UNIVERSE

FOLLOWING a method initiated by Vaidya,¹ Raychaudhuri² first considered the case of a mass particle being completely annihilated and converted into radiation. He found that such a process could not be adequately described by the field equations of relativity. However, Israel³ found that the relativity equations are adequate to describe such a process of complete conversion of a mass particle into radiation and he has given a model for the same.

In all these attempts, the mass particle was embedded in a Schwarzschild space-time and after conversion into radiation, the hollow created was empty (flat). It would be of interest to see how these conclusions are modified when the same process is studied not in the flat background, but in the background of a homogeneous universe.

Beginning with the static spherical Einstein universe given by

$ds^2 = -R^2 [d\chi^2 + \sin^2\chi (d\theta^2 + \sin^2\theta d\phi^2)] + dt^2$ (1)
we can choose a convenient radial co-ordinate x by the substitution $x = R \tan \chi$. Then (1) reduces to

$$ds^2 = -\frac{1}{(1+x^2/R^2)^2} dx^2 - \frac{x^2}{(1+x^2/R^2)} (d\theta^2 + \sin^2\theta d\phi^2) + dt^2. \quad (2)$$

The advantage of this particular choice of radial co-ordinate is two-fold: (i) The boundary radius R of the universe is reached in (1) at $\chi = \pi/2$ and therefore in (2) at $x \rightarrow \infty$. (ii) Closed as well as open non-static models can be discussed by a simple generalization of (2).

At $t = 0$, a particle at the origin starts emitting radiation. At $t = t_1$, the last material speck in the particle is converted into radiation. Then at any later time t we have a shell of radiation moving outwards from the origin.

On the outside of the shell is the static Einstein space-time, while on the inside we can have some other cosmological space-time. It is found that the O'Brien and Synge⁴ jump conditions at the two boundaries require that (i) the shell cannot be occupied by pure moving radiation only but should be occupied by a mixture of moving radiation and matter of non-

zero density,⁵ (ii) the pressure and density of matter within the shell pass over continuously at the two boundaries of the shell to the pressure and density of cosmic fluids on the two sides. (iii) we cannot have flat space-time on either side of the shell, and (iv) the curvature $1/R^2$ of the inner cosmic space is less than that of the outer one.

We have worked out a rigorous solution of the field equations of relativity which gives the gravitational field within the shell as described above. The line-element is

$$ds^2 = -\frac{\gamma^2}{x^2} \frac{1}{1+Px+Qx^2} dx^2 - \gamma^2 (d\theta^2 + \sin^2\theta d\phi^2) + \frac{x^2}{\gamma^2} \frac{1}{1+Px+Qx^2} dt^2 \quad (3)$$

with

$$\gamma^2 = e^{\psi(t)} (B + A\phi(t))^2 x^2.$$

Here P , Q , A and B are conserved functions along the world lines of flow of radiation with two relations between them.

At any time t , we take two null-surfaces $x = X_1(t)$ and $x = X_0(t)$, $X_1(t) > X_0(t)$. If we fit this solution with the Einstein static universe at $x = X_1(t)$ and with the expanding closed cosmic space-time at $x = X_0(t)$ satisfying all the necessary equations of fit, we can draw the conclusions as stated above. It is further found that by the time the surface $x = X_1(t)$ reaches the boundary of the Einstein static model, the other wavefront $x = X_0(t)$ also reaches the same boundary and thus the radiation shell vanishes over a sphere of discontinuity of the Synge⁶ type which has receded to infinity and the observable universe round the origin is the expanding cosmic model given by

$$ds^2 = -e^{\psi(t)} \left[\frac{1}{(1+x^2/R^2)^2} dx^2 + \frac{x^2}{(1+x^2/R^2)} (d\theta^2 + \sin^2\theta d\phi^2) \right] + e^{-\psi(t)} dt^2 \quad (4)$$

where

$$\frac{1}{R^2} < \frac{1}{R^2}.$$

Thus the effect of an explosion converting a material particle completely into radiation is to reduce the curvature of the universe. One can say that against a disturbance of this type a homogeneous universe of smaller curvature is more stable than one of larger curvature. Also by considering the accumulated effects of

a series of such conversions one can conclude that ultimately the observable universe round an observer will tend to become open with zero curvature.

M.N. College, Visnagar
and

M.G. Science Institute,
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June 4, 1959.

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K. B. SHAH.

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RADIOCHROMATOGRAPHY OF ALKALI EARTH IONS

IN an earlier investigation, acid-washed asbestos paper was used with success in the chromatographic separation of the alkali ions, Li^+ , Na^+ , K^+ , Rb^+ and Cs^+ with dilute hydrochloric acid as solvent.^{1,2} By a comparison of these results with those observed on Whatman filter-paper No. 1 impregnated with the resin Dowex-50, it was concluded that asbestos functions as a natural inorganic ion exchanger of capacity of the order of about 30 microequivalents per cm^2 of the paper, weighing on the average 30 mg.³

We have now extended the above method to a separation of the alkali earth ions, Ba^{++} and Sr^{++} labelled with their radioisotopes Ba^{133} and Sr^{90} . The former was obtained by a four-week irradiation of BaCO_3 by thermal neutrons in one of the nuclear reactors of Harwell, while the latter radioisotope Sr^{90} , in equilibrium with the daughter radioelement Y^{90} , was provided by the Radiochemical Centre, Amersham. Bands of asbestos paper, $35 \times 10 \text{ cm}$, were cut out of 0.2 mm. thick sheets washed with concentrated hydrochloric and nitric acids following the procedure reported earlier.¹ A mixture of Ba^{133} and Sr^{90} (+ Y^{90}) was spotted with about 2-3 mg. of the carrier elements in the form of chlorides along a line 5 cm. from one end of the above asbestos band. The chromatography was by ascending development using 0.1 N hydrochloric acid as solvent. When the development was complete, the band was dried and cut into a series of samples of 5 mm. width along the entire length from the origin to the front of the solvent. A specially

shielded end-window GM counter giving a background of 12 counts/min. was used to determine the repartition of radioactivity in the chromatogram, as a function of distance from the origin. Figure 1 shows the resulting separation of Ba, Sr and Y.

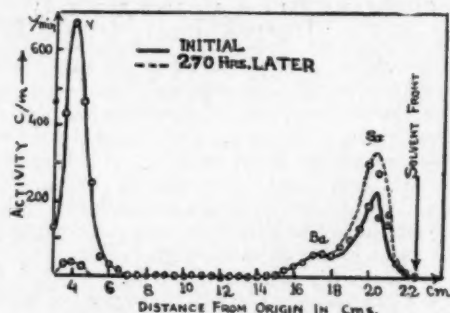


FIG. 1. Radiochromatogram of Ba, Sr and Y on acid-washed asbestos paper and 0.1 N HCl as solvent.

Decay characteristics of Ba^{133} , Sr^{90} and Y^{90} were used in distinguishing their positions in the chromatogram. Ba^{133} decays by K-capture with a period of > 20 years. The product Cs^{133} is stable. Sr^{90} is a β^- emitter with a period of 19.9 years. The daughter element Y^{90} also decays by β^- emission but with a period of 65 hours, the final product being stable Zr^{90} . A study of the time variation of the activities of these samples, initially separated, suffices to identify them. The activity of the peak corresponding to Y^{90} decays to nearly zero in about 2 weeks' time, while that of Sr^{90} grows to a constant maximum in the same time, the activity of the equilibrium mixture ($\text{Sr} + \text{Y}$) being double that of the initial parent element alone. Lastly, the activity corresponding to the Ba^{133} peak remains sensibly constant for periods of the above order. The curve shown by the dotted line in Fig. 1 shows the distribution of the activities in the chromatogram measured 270 hours after the initial distribution shown by the full curve had been recorded. Following are the R_f values for the chromatographic separation obtained:

Y: 0.18, Ba: 0.76, Sr: 0.90.

The above separation of the alkali earth ions on asbestos paper, with but dilute hydrochloric acid as solvent lends further support to our earlier conclusion, based on the chromatography of alkali ions,^{1,2} that asbestos functions as a natural ion exchanger. Incidentally, because of the large difference in the associated R_f values, the method serves as a simple means of obtaining carrier-free Y^{90} from its equilibrium mixture

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with Sr^{90} , an important fission product, without recourse to column chromatography employing synthetic ion exchanger resins and complex solvent mixtures. Further work on the separation of Ca, Sr and Ba is in progress.

Our grateful thanks are due to Prof. S. S. Joshi for his guidance and help.

Nuclear Chemical Laboratory, H. J. ARNIKAR.
Banaras Hindu University, O. P. MEHTA.
May 27, 1959.

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THE PREPARATION OF ANHYDROUS URANIUM TETRAFLUORIDE

The strong binding of the molecule of water to that of uranium tetrafluoride always leads to the formation of the compound $\text{UF}_4 \cdot \text{H}_2\text{O}$, whenever water is present either in the reagents, or is formed in the reaction process. Our attempts to prepare anhydrous tetrafluoride by the reaction of aqueous HF with uranium (IV) oxyformate¹ and oxyacetate² resulted in the formation of the hydrated compound. Even when the hydrated ammonium uranium fluoride complex, $\text{NH}_4\text{F} \cdot \text{UF}_4 \cdot \text{H}_2\text{O}^3$, was heated in vacuum the monohydrate tetrafluoride was obtained. Decomposition of the hydrated product occurs as indicated by the appearance of the black colour, if heating of the hydrated compound is continued at high temperature in vacuum. But when hydrated tetrafluoride is treated with HF at high temperature,⁴ the partially decomposed product, formed in the process of removal of water, is simultaneously converted back to tetrafluoride. The non-existence of water automatically excludes any possibility of association with water when the product is cooled.

Anhydrous uranium (IV) tetra-acetate $\text{U}(\text{CH}_3\text{COO})_4$ and ammonium bifluoride $\text{NH}_4\text{F} \cdot \text{HF}$ were chosen as the starting materials as none of them contain water or produce it when reaction occurs. When an intimate mixture of the two was heated in vacuum, the anhydrous complex $\text{NH}_4\text{F} \cdot \text{UF}_4$ was obtained (*loc. cit.*). The thermal decomposition of the anhydrous complex in vacuum at about 450° gives the anhydrous tetrafluoride. The extremely hygroscopic nature of the ammonium complex necessitates the precautions for avoiding exposure to moisture. The analyses carried out by the method reported earlier (*loc. cit.*),

as recorded in Table I, show that the compound obtained is anhydrous tetrafluoride.

TABLE I
Estimation of Uranium as U_3O_8 and Fluoride as CaF_2 Weights in mg.

Compound taken	U_3O_8		CaF_2	
	Calcd.	Found	Calcd.	Found
116.6	104.3	104.0	57.9	57.2
123.0	109.9	109.0	61.5	61.2
199.0	177.8	176.2	98.9	98.6
224.0	200.2	198.0	111.0	110.6

The method described above does not include the high temperature treatment of HF^5 or freons^{6,7} and thus provides an alternative method for the preparation of anhydrous uranium tetrafluoride.

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May 25, 1959.

BALARAM SAHOO.
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FREE AMINO-ACIDS IN THE BLOOD OF SOME VERTEBRATES

The blood of vertebrates as well as of invertebrates has been studied extensively in recent times.²⁻⁶ However, free amino-acids of the vertebrate blood have not been studied, even though Paper Chromatography provides an excellent technique for such an investigation. In this note we are reporting the qualitative and semi-quantitative distribution of free amino-acids in the blood of frog (*Rana tigrina*), pigeon (*Columba livia*), fowl (*Gallus domesticus*) and bandicoot (*Bandicota indica*).

For the detection of free amino-acids, blood was first pipetted into three times its volume of absolute alcohol to precipitate the proteins.

After centrifuging, the protein-free alcoholic extract was mixed with three times its volume of chloroform. The aqueous layer formed on top of the chloroform-alcohol mixture was used for chromatographic separation of free amino-acids. Free amino-acids were studied by circular as well as two dimensional chromatography. Butanol-acetic acid-water (4:1:5) was used as the solvent for circular, and secondary Butanol-formic acid (80%)-water (30:4:6) and 80% phenol for the first and second runs respectively for two-dimensional chromatography. Results are given in Table I.

TABLE I

Free amino-acids and related compounds in the blood of some vertebrates

	Frog	Pigeon	Fowl	Bandicoot
Aspartic acid	.. ++	+½	+½	+
Glutamic acid	.. +++	+++	+++½	+½
Alanine	.. +	++	+++½	+++
Arginine	.. +	Trace	+½	++
Cystine	.. +++	+++	+++	++
Glycine	.. +	++	+	+
Histidine	.. +	+	+	++
Leucine-Isoleucine	+½	+	+	+
Lysine	.. +½	Trace	Trace	Trace
Methionine	.. ++	--	--	--
Phenylalanine	.. +	Trace	Trace	+
Proline	.. Trace	--	--	--
Serine	.. +	+	++	+
Threonine	.. ++	Trace	+	+½
Tryptophane	.. +	--	--	+
Tyrosine	.. +	+	Trace	+
Valine	.. ++	--	--	--
Taurine	.. +	+++	+++	++
Glutamine	.. +	++	++	++

+++ = Very prominent; ++ = Prominent; + = Present; -- = Absent.

An examination of the results shows that 19 free amino-acids are present in the blood of frog, 16 in bandicoot and 15 in pigeon and fowl. Of the essential amino-acids, leucine, isoleucine, lysine, phenylalanine and threonine are present in all. But methionine and valine are present only in frog, and tryptophane is present in frog and bandicoot. Of the sulphur containing amino-acids, cystine is present in all, in more or less the same concentration but methionine is found only in frog. It is interesting to note that a number of non-essential amino-acids is present in appreciable quantities in all the four animals examined. This is not surpris-

ing as they are known to contribute towards essential physiological functions.

Comparing the results with those of invertebrates like *Panulirus*, *Scylla* and *Telescopium*, it is seen that there are more free amino-acids in the vertebrate blood than in invertebrates. Glycine, serine, arginine, histidine, lysine, alanine, glutamic acid and threonine have been reported in the blood of *Panulirus*. All these except glutamic acid, threonine and proline are present in *Scylla* while all listed for *Panulirus* except glutamic acid and alanine, and in addition leucine, methionine and valine are present in *Telescopium*.⁷ This may mean that the amino-acid requirements of invertebrates are much less than those of vertebrates or perhaps they can synthesize their requirements to a much greater extent than vertebrates. It is now well established that the amino-acid nitrogen content of plasma in insects is very high. The nature of the amino-acids found in the internal medium of insects is still insufficiently known. In *Dytiscus*, for example, the search for arginine, tryptophane, phenylalanine or cystine gave negative results. The plasma concentration of histidine is about 30 mg.% and of tyrosine 117 to 168 mg.% (106 mg.% of total amino-nitrogen in plasma).¹ The amounts of these two amino-acids are very high as compared with other animals. The nature of the largest portion of amino-acids in the blood plasma of insects is still undetermined. In the absence of such information comparison with the present results is not possible.

Ahmednagar College,
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April 4, 1959.

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A NEW TURBIDIMETRIC METHOD FOR THE DETERMINATION OF THALLIUM (I)

BECAUSE of the extreme toxicity of thallous salts it is often necessary to detect and determine thallium in microquantities. Of the various methods adopted for its estimation, the colorimetric procedures depend essentially on the complexes formed by thallium with organic and inorganic reagents.^{1,2} The oxidation of

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thallium (I) by selenious acid and the quantitative aspect of this reaction have been reported earlier from these laboratories.³ The formation of the red sol of selenium in this reaction has now been utilised for the turbidimetric determination of thallium.

In the present procedure, aliquots of selenious acid were mixed with varying amounts of thallous solution and the acidity was raised to 4-6 N with hydrochloric acid. 5 ml. of 1% solution of gelatine was added as stabilizer and the volume was made up to 10 ml. Extinction readings, with 5 ml. of the mixture, were taken with the Hilger Spekker absorptiometer model H 760, using one of the three filters, greenish-blue, bluish-green or green having a total transmission range of 490-550 m μ . These readings were found to be linearly proportional to the concentration of thallium in the range 10 to 100 p.p.m. From a standard curve, as little as 1 to 2 p.p.m. of thallium in an unknown sample, could be determined with a maximum error of about 2%. It was necessary to add an excess of Se^{iv} to ensure complete oxidation of Tl (I) to Tl (III). After an equivalent of Se was formed there was no change in the absorption of the sol with more addition of selenious acid indicating the absence of Thallium (I) in the solution.

In the study of the effect of varying acid concentration, on the reaction, it was observed that for the solutions of selenite and thallium (I) in the concentration range 0.1 M to 0.001 M, the required overall normality of HCl for the full development of the red turbidity was about 4-6 N. At a lower normality thallous chloride precipitated and at a higher acid concentration the suspension of metallic selenium tended to go into solution.

At room temperatures, the complete formation of the red sol required about half a minute after the mixing of selenium and thallium solutions, while at an elevated temperature ($\approx 50^\circ\text{C}$.) the colloidal suspension appeared instantaneously. The intensity of the colour, which probably depended upon the size of the particles, was almost the same within a temperature range of 40-60 $^\circ\text{C}$. However, the colour of the sol varied from yellowish red (between 20 $^\circ\text{C}$. to 40 $^\circ\text{C}$.) to pink violet (60 $^\circ\text{C}$. to 80 $^\circ\text{C}$.).

It was also observed that foreign ions, excepting those of the strong oxidising and reducing agents, had little influence on this reaction.

The reaction is quantitative and may also be used for the determination of selenium when it is necessary to add an excess of thallium (I)

solution to Se^{iv}. The method is simple, easily workable and sufficiently accurate.

Sincere thanks of the authors are due to Prof. S. S. Joshi for kind interest and facilities. Chemical Laboratories, G. S. DESHMUKH, Banaras Hindu University, S. V. TATWAWADI, Banaras-5, India, M. S. VAIKUNTAM, May 18, 1959.

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THERMAL STABILITY OF ALLINASE- AND ENZYMATIC REGENERATION OF FLAVOUR INODOURLESS GARLIC POWDER

It is known that garlic in its natural condition does not exhibit any flavour, but as soon as it is injured, peeled or macerated, a very strong garlic odour develops due to the enzymatic cleavage of *allin* into *allicin*, the chemistry of which has already been discussed elsewhere.¹ The enzyme *allinase* involved in this process is sensitive to heat and has been reported to be inactivated on steam bath in 30 minutes.² Besides, Stoll and Seebeck² have studied some properties of allinase with respect to time, temperature, pH, organic solvents and storage stability, etc., but have not indicated the minimum time for the inactivation of allinase in boiling water. In order to study the thermal stability of allinase, some lots of fresh garlic cloves were blanched in boiling water for 2.5, 5, 7.5, 10, 12.5, 15 and 20 minutes respectively and immediately analysed for their antibacterial potency, by the cup plate method.^{3,4} None of the such treated samples showed any antibacterial activity (A.B.A.), indicating inactivation of allinase even at 2.5 minutes' blanching.

A bigger batch of odourless garlic powder was then prepared from a 4 lb. lot of fresh garlic after blanching it for 5 minutes (to ensure complete inactivation of the allinase) before giving the usual mechanical treatment⁵ prior to dehydration and was analysed for allyl sulphide,^{6,7} antibacterial activity,^{3,4} colour and flavour and the results (Table I) compared with the control (without blanching). The A.B.A. and flavour in the powder prepared from the blanched garlic was almost completely destroyed,

thus confirming the inactivation of allinase within 5 minutes of blanching in boiling water. The colour of the finished product was more white than that of the control sample. This may probably be due to the inactivation of other enzymes like peroxidase and catalase. Qualitative tests for both these enzymes gave negative results.

TABLE I
Effect of blanching on the quality of garlic powder

Treatment	Moisture	% Allyl sulphide F.W.R.	A.B.A. (mm.)	Colour (Tintometer Units)	
				R	Y
Control	..	7.0 0.33	10	1.4	2.2
Blanched in boiling water for 5 minutes	..	7.1 0.22	Nil	1.1	1.1

Most of the vegetables, before their dehydration, are steam or water-blanching in order to check the undesirable changes in colour and flavour, etc. But the above results (Table I) indicate that blanching is quite unsuitable for dehydration of garlic as garlic powder is valued more for its flavour than colour. However, from the pharmaceutical angle, blanching helps in the preparation of odourless garlic powder in which the active antibiotic—allicin and flavour can be regenerated at will by incorporation of suitable enzymatic extracts as demonstrated below:

ENZYMATIC REGENERATION OF FLAVOUR IN ODOURLESS GARLIC POWDER

The odourless garlic powder prepared as above was treated with crude enzyme (allinase) solution prepared from fresh garlic by the method of Stoll and Seebeck.² Three narrow sample-tubes containing (i) Starch + Enzyme extract, (ii) Odourless garlic powder + Enzyme extract, (iii) Odourless powder + distilled water equivalent to the enzyme extract were evaluated for allicin,³ allyl sulphide, A.B.A. and overall flavour.

The results (Table II) clearly indicate the cleavage of allin (which could not be split up earlier and was lying dormant as a potential source of flavour) into allicin. The value of allicin which is only 539.9 mg./kg. in odourless powder (lot I) is increased to 2,537 mg./kg. and allyl sulphide content increased from 0.22% to 0.395% (corrected for corresponding values for the enzyme extract alone). The antibacterial activity was also reactivated on addition of the

TABLE II
Enzymatic regeneration of flavour in odourless garlic powder

Sl. No.	Treatment	Allicin mg./kg.	Allyl Sulphide %	A.B.A. (mm.)	Flavour
I	Odourless garlic powder	.. 539.9	0.22	Nil	Poor
II	Odourless garlic powder + 10 ml. of 5% enzyme extract	.. 3,293.0	0.50	13*	Good
III	5% enzyme extract alone	.. 756	0.105	Nil	..

* 1.70 of garlic powder + 5 ml. of 5% crude enzyme extract, volume made up to 50 ml. 0.05 ml. of it was utilised for A.B.A.

enzyme solution whereas the enzyme solution by itself in the concentration used did not have any antibacterial potency. The diameter of zone of inhibition was 13 mm. as compared to nil in the case of odourless powder.

The objective flavour evaluation of the tubes, prepared as discussed earlier, clearly indicated increased fresh flavour development in the case of enzyme-treated odourless garlic powder due to liberation of allicin. The starch containing the enzyme preparation did not show any flavour. The odourless powder mixed with distilled water also did not exhibit any flavour indicating thereby that presence of allinase is essential in the generation of allicin from allin present in the odourless garlic powder.

Grateful acknowledgment is made to Dr. V. Subrahmanyam, Director, for the keen interest in these investigations and to Shri V. Sreenivasamurthy for the help in determining the antibacterial activity.

Central Food Technological
Research Institute,
Mysore,
April 18, 1959.

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L. J. SINGH.
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ISOTOPE DILUTION TECHNIQUE IN
THE STUDY OF INTERCONVERSION
OF THE LOWER FATTY ACIDS IN
IN VITRO INCUBATION OF RUMEN
CONTENT OF SHEEP

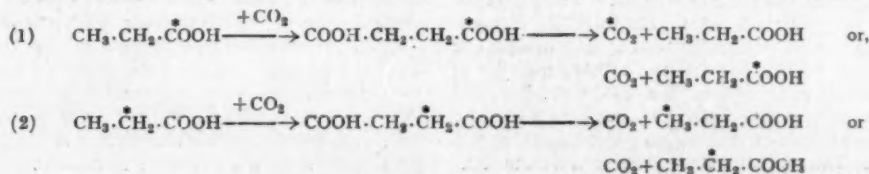
RUMEN samples from fistulated sheep were collected soon before offering the morning quota of concentrates, under CO_2 atmosphere, and incubated at 39°C . for 3 hours in an atmosphere of CO_2 with 1-C-14 labelled acetate, propionate and butyrate in turn. A few samples were collected after 20 hours of fasting. The acetic, propionic and butyric acids in the rumen content were quantitatively separated by liquid-liquid partition chromatography, using Celite 535 as the inert support, 2 molar phosphate buffer of pH 6.5 as the stationary phase and chloroform-butanol mixtures as the mobile phase. For the separation of butyric, valeric and caproic acids a buffer of pH 7.6 was used (Bueding and Yale, 1951). The specific activity of the sodium salts of the volatile fatty acids, separated by chromatography, was measured by evaporating to dryness an aliquot of the chromatographic fractions, dissolving the residue in a known small volume of water plating a convenient aliquot (containing about 5 micro-moles of the sodium salt), and counting its activity in a Geiger counter. The specific activity, when multiplied by the total amount of the salt present in each chromatographic fraction, gave the total activity in that fraction. The initial and final specific activities of acetic, propionic, butyric and valeric acids were thus determined and the total activity in each was calculated. The total activity in CO_2 was also measured in a few experiments. The CO_2 of the incubation flasks was absorbed in N/10 NaOH for 1 hour in absorption towers, and its activity was measured as BaCO_3 .

These experiments clearly indicated that, excepting with active butyrate, where activity transfer into acetate was 12.9% of the initial activity added, in the sample from a non-fasting sheep, and 29.3% from a fasting animal, the inter-transfer of activity amongst the acids was less than 3% in 3 hours. An interesting feature noticed was that with active propionate much more activity was present in the valeric

compared to the butyric acid, indicating the possibility of condensation of two molecules of propionic acid to form a molecule of valeric acid—a reaction going in the reverse direction to the familiar Beta-oxidation process. This finding is in agreement with that of Popjack in a lactating goat (Popjack, 1951). With active acetate, however, both propionate and butyrate showed some activity (about 2% each). The activity in the propionate may be due to decarboxylation of succinic acid (Elsden and Sijpesteijn, 1950) which is formed in course of the oxidation of acetic acid through the citric acid cycle.

The amount of activity transferred to CO_2 presented many interesting points. When expressed as percentage of the initial activity of the fatty acid added, it was 0.6% with 1-C-14 acetate, 32.8% with 1-C-14 propionate, nil with 2-C-14 propionate, and 5.2% with 1-C-14 butyrate. The high CO_2 activity with 1-C-14 propionate is most probably due to the reversible reaction $\text{Propionate} \rightleftharpoons \text{Succinate}$ taking place fairly rapidly, as has been observed by Pennington with rumen epithelium (Pennington, 1952). This hypothesis is further corroborated by our observation that no activity was detected in the CO_2 when 2-C-14 propionate was used in place of 1-C-14 propionate in the incubation. The course of events with the two differently labelled propionates are represented below.

The total recovery of activity from the different acids and CO_2 combined also presented certain interesting points. With 1-C-14 acetate in the non-fasting sheep, all the initial activity was recovered in the acetate, propionate and butyrate; while in a fasting animal only 81% was recovered. Since, in a separate experiment with 1-C-14 acetate in a fasting animal, only 0.6% of the initial activity was found in the CO_2 , it seems highly probable that, at least in the fasting state some acetate may be converted into ketone bodies, or into the many intermediate compounds of the citric acid cycle. With 1-C-14 propionate, in a fasting animal, whole of the initial activity was recovered in the three acids and the CO_2 , indicating very little, if any, loss through ketone bodies or the



citric acid cycle. With 1-C-14 butyrate, however, as much as 35% of the initial activity was unaccounted for. This loss can readily be explained by the possible formation of ketone bodies which is known to be an important pathway in the metabolism of butyrate (Dakin, 1921; Pennington, 1952).

This work was carried out at the Rowett Research Institute, Bucksburn, Aberdeenshire, Scotland, while on deputation from the Bihar Government during 1957 and 1958. The author wishes to express his grateful thanks to the Director Dr. D. P. Cuthbertson, for kindly offering very liberal facilities for the work, to Dr. R. J. Pennington for suggesting the problem and for very valuable guidance in course of the work, and to Mr. R. Green for generous technical assistance.

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Patna, April 27, 1959.

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A NOTE ON THE OCCURRENCE OF CHALCOPHANITE IN THE MANGANESE ORES OF TIRODI, BALAGHAT DISTRICT, M.P.

CHALCOPHANITE, a hydrous manganese-zinc oxide with the composition $(\text{Mn}, \text{Zn}) \text{O.2 MnO}_2 \cdot 2\text{H}_2\text{O}$, has not, to the best knowledge of the author, been reported from any locality in India in the manganese ores associated with the gondites. It is found as needles and fine-grained aggregates in association with the secondary manganese minerals Pyrolusite and Psilomelane which vein and replace a Jacobite ore associated with highly metamorphosed rocks like Biotite-gneiss, Gondite and Sillimanite-mica-schist belonging to the Mansar stage of the Sausar Series of Dharwar age.

The properties of the mineral are as follows: It does not take a good polish. Colour: Grey-white to very dark grey. Reflectivity: Low to moderate. Maximum reflectivity slightly higher than that of Psilomelane and minimum reflectivity much lower than that of Jacobite. The values for green light (Maximum 29.5 and minimum 10) in air were determined by the Visual Microphotometer. Pleochroism: Ex-

tremely strong. Anisotropism: Extremely strong but without any typical colours. Extinction often undulose but when not so, four distinct extinctions per revolution are seen. Often shows red internal reflections, especially in oil. Hardness: Very low. The value of Vicker's hardness (ranging from 265 to 350) was kindly determined by Prof. Sripad Rao Kilpady. The mineral does not show any cleavage, probably due to its fine-grained nature.

ETCH REACTIONS

Positive.— HNO_3 —(concentrated); HCl —(concentrated), reagent turns brown; Aqua regia—reagent turns brown. Stains some grains brownish; H_2O_2 —strong effervescence. Probably tarnishes some specimens. SnCl_2 (saturated) + HCl (concentrated)—Tarnishes distinctly.

Negative.— HNO_3 , HCl , KCN , KOH , HgCl_2 .

The extremely strong pleochroism and anisotropism, the markedly high difference between the maximum and the minimum reflectivity values, the red internal reflections, the distinct extinctions, the very low hardness, the association with secondary minerals like Pyrolusite and Psilomelane and the etch reactions are characteristic of Chalcophanite.

X-ray and chemical study, to corroborate the evidence of optical study, will be undertaken very shortly.

The author is greatly indebted to Prof. Sripad Rao Kilpady, Head of the Department of Geology, Nagpur University, for his valuable guidance.

University Department of S. P. DESHPANDE,
Geology,
Nagpur,
June 24, 1959.

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SIGNIFICANCE OF APPLICATION OF NITRATE FERTILIZERS IN PADDY SOILS

EXPERIMENTS with nitrogen fertilizers were carried out in acid meadow paddy soil and alkali soil without lime content in the surface layer. The aim of these field experiments was to compare the effect of ammonium sulphate and fertilizers containing nitrate. In certain years considerable differences were found in the crop in spite of the identical treatment.

Yield lower year, cool, 170 kg. appear average (control) same year to the was co

In the however 50-7-5 (control) striking favour chiefly such of the oxygen effect i.e., th shows the m

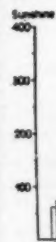


FIG. 1
from 1 Br

The tion d ing d tions. dress It ha that plant disap It h effect main

Yields obtained in 1955 were significantly lower than those of the later years. In this year, when the weather was very cloudy and cool, 340 kg. ammonium sulphate basal and 170 kg. top-dressing per hectare, favoured the appearance of the browning-disease and the average yields reached from 5.8 to 10.2 q (control: 13.6-17.0 q) per hectare. In the same year in certain areas known as susceptible to the browning disease due to H_2S , the yield was completely ruined.

In the following years (1956, 1957, 1958), however, the average yields obtained amounted to 50.7-55.6 q per hectare with the same treatment (control: 20.4-28.9 q). The cause of the striking differences is to be attributed to the favourable weather conditions of these years, chiefly to the abundant radiation. Under such conditions the vigorous synthetic processes of the rice plant provide such a quantity of oxygen that is sufficient to overcome the toxic effect of H_2S , forming in the waterlogged soil, i.e., the cause to browning disease.¹⁻⁴ Fig. 1 shows the radiation and mean temperature of the months of experimental years.

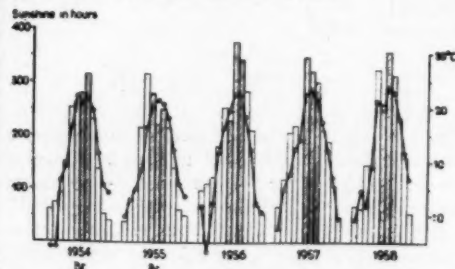


FIG. 1. Radiation and mean temperature of the months from 1954-58.

Br = Browning diseased years.

— = Temperature.

▨ = Radiation.

▨ = June, July, August.

These experiments showed that the application of ammonium sulphate favours the browning disease under unfavourable weather conditions. Applying the nitrate fertilizers in top-dressing the result was remarkably different.⁵ It has been repeatedly stated also in our trials that NH_4-N is the source of N for the paddy plants,^{3,5,6} all the more as the NO_3-N disappears in the days following the flooding.⁴ It had been noted in 1955 the beneficial effect of the nitrates, after stem elongation, was mainly in heading. On the basis of this experi-

ence experiments were carried out in the following years. Sulphate-nitrate fertilizers applied together at the time of stem elongation (200-200 kg. ammonium sulphate and ammonium nitrate) following the 340 kg. $(NH_4)_2SO_4$ basal fertilizers, yielded 56.4-64.2 q (control: 27.2-30.6 q) in 1957 and 1958 under very favourable weather conditions.

Laboratory experiments were made to elucidate definitely the beneficial effect of nitrate fertilizers applied at the time of heading. Ammonium sulphate and ammonium nitrate in addition to synthetic and natural Chilean potassium and sodium nitrates were used. It has been stated that the organic substances (i.e., cellulose) decomposing in an aerobic condition in waterlogged soils renders possible the sulphate reduction and formation of H_2S . On the other hand, the nitrate fertilizers applied together with ammonium sulphate prevent the formation of H_2S and oxidise the FeS already produced.

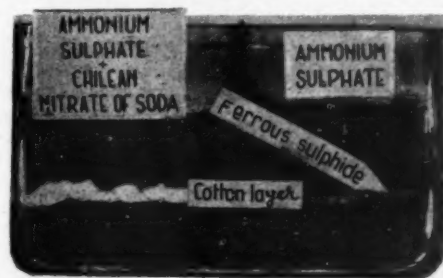


FIG. 2. The nitrates preventing the formation of H_2S . As in Alberda's opinion⁷ the rice plant in generative phase, i.e., in time of heading supplies less oxygen for the roots, the fertilizers containing nitrates, as oxidising compounds, may give considerable help to overcome the toxic effect of H_2S .

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ISOLATION OF A PERENNIAL
SORGHUM

THE present report is the result of the attempt to evolve a rust-free strain of sorghum by natural selection and segregation carried over from generation to generation from 1936 to 1954, with the least interference with the economy of nature.

The problem was undertaken in 1936 at the Experimental Dairy and Farm started by the author at Mothrawala. Medium size sorghum seeds were purchased from the local market for sowing. Selection, segregation or isolation of seedlings, which were rust-free or comparatively less affected, was carried on till they were at the maximum six weeks old. No discrimination was made while collecting or sowing the seeds. Sowing and harvesting was done annually at the usual season till 1954.

During the progress of the work the author often lost almost all the plants and seeds and had to depend on vegetative propagation or had to continue the work with a few seeds only. The feasibility of the problem was indicated by the few plants in 1937 with only the lower few leaves affected with rust. The perennial nature of the sorghum was noticed in 1945 but no importance was attached to it then. The strain became almost rust-free in 1947, but no seeds could be obtained owing to heavy infestation by aphids. No seeds could be obtained from 1950 to 1953, but in 1954 seeds appeared bold for the first time. Enquiries at Agricultural Research Institute, Delhi, Coimbatore and at other agricultural farms revealed that no perennial sorghum was evolved or cultivated in India, so further study of the perennial sorghum thus isolated interested the author.

CHARACTERISTICS

Under the climatic conditions of Dehra Dun the strain of sorghum isolated is not only of a perennial nature but is also a perpetually blooming and seed-producing variety, provided the winter minimum temperature does not fall below 10° C. and the maximum summer temperature is not above 40° C. Beyond these temperature limits very few or practically no seeds are formed. Once sown it lasts for years or as long as moisture and nutrition are available from the ground, and several crops can be obtained in a year. Heavy rains, hailstorms, or droughts have practically no effect on it. It has great adaptability to its environment; on non-irrigated lands under unfavourable conditions it remains quiescent, but revives on return of favourable conditions. Its yield of

grain is incredibly large. Field trials from 1956 to 1958, conducted on irrigated plots of 1/40 of an acre, on grounds attached to the District Jail, have shown that it is possible to obtain 16,000 to 20,000 lb. of grain per acre. Its maximum yield and number of crops may be expected, at places where the summer maximum temperature does not go above 40° C. and the winter minimum below 10° C. The details of the work will be published in due course.

Most of the work reported here was done on non-irrigated and irrigated lands in Dehra Dun at the following villages. Mothrawala, Chalgaoon, Asthal, Dhoran, Danda-Lakhond, Shemshargarh, Karavan Gaon, Kaulagarh and Ballupur, with the kind help and co-operation of late Shri Mahant Laxman Das and Col. S. Blake and Mr. E. Young, Principal, Normal School, among others, in their respective villages and farms. Author's thanks are due to them and to Shri B. D. Arora and Shri M. M. Srivastava the then Jailors by whose courtesy the field trials could be conducted.

Micro Technical Research
Labs. (Private),
Dehra Dun,
April 28, 1959.

B. S. SHARMA.

SEX REVERSAL IN HEMP BY
APPLICATION OF GIBBERELLIN

Cannabis sativa L. under normal conditions of growth behaves as a dioecious plant. However, the sex in this plant can be reversed by alteration of cultural conditions as well as by application of auxins. Tibeau¹ obtained only female plants in high nitrogen and only male plants in low nitrogen in sand culture. According to McPhee² both time of flowering and sex in hemp are determined by light. Breslavetz³ showed that extreme shortness of day causes sex reversal in hemp. Heslop-Harrison⁴ observed that application of α -naphthalene acetic acid induced the formation of female flowers in genetically male plants. In the present investigation application of gibberellin has been shown to induce formation of male and hermaphrodite flowers in the genetically female plants.

Seedlings of *C. sativa* were transplanted into 10 inch pots at the 4-leaf stage. They were treated at weekly intervals with a 100 p.p.m. aqueous solution of gibberellin (Pfizer) by foliar spray. Ten plants were thus treated and an equal number of plants was used as control. The pots were kept under partial shade throughout the duration of this experiment. Flowering commenced at the end of four weeks after

the first application of gibberellin in case of both treated and control. Observations on flowering behaviour were continued for six subsequent weeks.

Out of the ten treated plants, five plants bore only male flowers throughout. These gibberellin-treated male plants had very conspicuous long panicles as compared to the untreated male plants where the flowers are borne in short axillary racemes. The number of flowers in the treated male plants was also much more than that in untreated plants.

Out of the remaining five treated plants only one was purely female and did not show any sex reversal, while the remaining four were genetically female, but each started as a male and later reverted to female. The number and extent of male flowers produced on such genetically female plants was variable. In general, first male flowers, two to five in number, appeared about the leaf axil of the sixth node. The male flowers continued for the next one to three nodes. This was followed by two to three nodes bearing only two female flowers in each leaf axil, one each on either side of the axillary axis. On subsequent nodes long axillary spikes were borne. On these lateral spikes again the male flowers preceded the female flowers (Fig. 1). In the

characteristic of female flowers, containing a cup-shaped perianth, an ovary with a distinct style and partly protruding anthers.

In the case of untreated plants, six were male and remaining four were female. Out of the four female plants only one showed slight tendency towards maleness. In this plant a single male flower was produced at the sixth node and all subsequent nodes produced only female flowers.

In order to prove that the plants, in which male flowers preceded the female flowers, were actually genetically female, gibberellin was applied at flowering stage to a normal plant which was producing only female flowers. The spikes on this plant, formed subsequent to the gibberellin application, bore male flowers followed by female flowers. This showed further, that gibberellin caused reversal of female to male during the period of differentiation of flower primordia.

From the observations described in the foregoing, it is clear that gibberellin brings about maleness in genetically female plants. In spite of the voluminous work on gibberellin as is recently reviewed by Stowe and Yamaki⁵ and Wittwer and Bukovac,⁶ no effect of gibberellin on the sex of dioecious plants is described. This is the first report showing that gibberellin can cause sex reversal in a dioecious plant. It is of significance⁶ that gibberellin consistently increases the number of staminate flowers preceding the first pistillate flowers in cucumber. In the light of this it is likely that the gibberellin, in case of female hemp plants, greatly enhances the tendency of the formation of male flowers. Such tendency pre-exists to a limited extent in the genetic material used in the study.

The author is indebted to Prof. P. N. Mehra for granting facilities for this work and for helpful suggestions. Thanks are also due to Dr. Dave Carew of the University of Iowa for furnishing the sample of gibberellin.

Pharmacognosy Department, C. K. ATAL.
Panjab University,
Amritsar, May 20, 1959.



FIG. 1. A spike from the treated female plant showing male, hermaphrodite and female flowers in succession. axils of first two to three bracts on these spikes only male flowers were formed followed by one or two hermaphrodite flowers and in the terminal portion of the spike only female flowers were formed. The male flowers thus formed on genetically female plants produced normal pollen grains. The hermaphrodite (Fig. 1A) flowers had an ensheathing bract,

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OIL FROM THE SEEDS OF ACACIA DECURRENS WILLD.

A NUMBER of Acacias, both indigenous and exotic, have been grown in India principally for their tanbarks. *Acacia decurrens* Willd., is one such exotic largely grown on the Nilgiris and also latterly in Uttar Pradesh.

This note records the properties of the fixed oil from the seeds of *Acacia decurrens* Willd. The oil was prepared in a yield of 9.41% by solvent extraction of the powdered mature seed with ether in a Soxhlet.

The oil deposited a white flocculent sediment. The clear oil had the following properties:

Appearance	.. Clear oil, showing some white flocculent sediment at the bottom of the container.
Colour	.. Pale-brown.
Odour	.. Peculiar, resembling that of Mustard oil group.
Acid value	.. 10.5.
Refractive index at 40° C.	.. 1.4707.
Saponification value	.. 190.8.
Iodine value	.. 137.1.
Percentage of oil obtained	.. 9.41.

It will be seen that the Iodine value compares favourably with that of other well-known drying oils. This suggests a profitable outlet from the seeds of *Acacia decurrens* Willd. estimated at some 1,000 lb. per year per acre in the Nilgiri area.

Work on the fatty acids of the oil is in progress. The author thanks Sri. K. S. Srinivasan, Curator, for help and encouragement.

Industrial Section, G. V. SUBBA RAO.
Indian Museum, Calcutta,
July 22, 1959.

EFFECT OF HORMONES ON THE SEX-RATIO IN MANGO

CHOUDHARI (1957) reviewed literature on "The possible significance of photo-period and hormones in sex-expression and sex-reversal in plants" and suggested that sex-reversal in plants may be due to hormone change. According to Over Beek (1952) treatment of plants with Naphthalenacetic acid speeds up appearance of female flowers in cucurbits. Nitsch et al. (1952) also observed that low temperature causes a very rapid transition of the plants to female phase. This again may be due to the

effect of low temperature on the concentration of hormones. With these references in hand a preliminary trial was arranged on February-March flush of Kalapady variety of mango, introduced into Bihar from South India. This variety when newly introduced in Bihar in 1935 was flowering three times in a year up to 1947, once in November-December again in February-March and a third time in April-May. Since 1947, however, there are only two flushes, once in February-March and again in April-May. It has been noted that the flowers formed in February-March and again in April-May differ in sex-expression, the first flush having nearly 99% male flowers.

Hormone treatment consisted of aqueous sprays of B-Naphthalenacetic acid in 0, 50 and 100 p.p.m. concentrations on the whole plants just before the onset of flower buds. Teepol was used as an adhesive agent. The treatments were replicated 6 times. Five uniform panicles were selected from each tree for flower count. Each panicle was enclosed in a muslin bag which could be opened when required. The dried flowers that fall into the bags were counted daily. The results are presented in Table I.

TABLE I

Treatments	Average No. of flowers per panicle		% of female flowers to total	Ratio of male to female
	Male	Female		
1 Control	573	29	4.8	20:1
2 B-Naphthalenacetic acid 50 p.p.m.	548	40	6.8	14:1
3 B-Naphthalenacetic acid 100 p.p.m.	480	53	9.9	9:1
C.D. at 5%			± 2.44	

It is evident from Table I that spray of hormone at both concentrations has significantly increased the ratio of female flowers.

Agric. Research Inst.,
Sabour (Bhagalpur),
May 21, 1959.

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R. K. SAHAY.
D. L. SINGH.

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STUDIES ON HETEROTHALLISM—V
Daedalea flavidia Lév.

THE problem of sex in Hymenomycetes is considerably complicated by the occurrence of 'physiological heterothallism of multiple allelomorph type' (Whitehouse, 1949). The modern tendency of the workers in this field is to regard heterothallism as a device which increases outbreeding by reducing the chances of fertile mating between haploids from one diploid individual (Mather, 1942). The study of sex and sex-groups in the members of this group of fungi is, therefore, of great biological importance and researches on the sexuality of Hymenomycetes commonly occurring in India have steadily been extended by several workers during the last two decades. The present investigation has been carried out on *Daedalea flavidia* Lév., a common polypore of tropical and sub-tropical India, and this forms a part of the series previously mentioned by the writers (Banerjee and Samadder, 1957).

The fact that in *D. flavidia* the mycelium of polyporous origin produces abundant clamp-connexions but these are not met with in the mycelium developed from a single spore induced the writers to assume the heterothallic nature of the species. In order to solve the enigma mating experiments with mycelia of monosporous origin were, therefore, undertaken.

Twenty monosporous cultures were made following the usual dilution method (Smith, 1954) from spores obtained from a single sporophore growing on logs of *Shorea robusta* Gaertn. f. Of the twenty cultures lacking clamp-connexions, fifteen were paired in all possible combinations on 2.5% malt-agar slants (pH 6) in tubes and allowed to grow for one month under ordinary conditions of temperature (28°–32° C.) and diffused light of the laboratory. After one month's growth the line of contact between two interacting mycelia was critically examined for the presence of clamp-connexions and the types of reactions exhibited were recorded. The results of these examinations are given in Table I. The presence or absence of clamp-connexions has been considered as the criterion of the compatibility or incompatibility of the interacting hyphae of a testing pair. Compatible reaction indicated by the presence of clamp-connexions has been designated by the (+) sign and all other incompatible reactions showing absence of clamp-connexions have been designated by the (–) sign.

From Table I, it is evident that *D. flavidia* is 'heterothallic' and sexually 'bipolar'. The

interacting mycelia fall under two mating types and any member of one type is compatible with any member of the other type. Table I also indicates that the two types are intercompatible

TABLE I

Pairing of 15 monosporous mycelia derived from a single sporophore of *Daedalea flavidia* Lév.

		A						a								
		1	6	8	9	10	11	12	2	3	4	5	7	13	14	15
A	1	—	—	—	—	—	—	—	+	+	+	+	+	+	+	+
	6	—	—	—	—	—	—	—	+	+	+	+	+	+	+	+
	8	—	—	—	—	—	—	—	+	+	+	+	+	+	+	+
	9	—	—	—	—	—	—	—	+	+	+	+	+	+	+	+
	10	—	—	—	—	—	—	—	+	+	+	+	+	+	+	+
	11	—	—	—	—	—	—	—	+	+	+	+	+	+	+	+
J	12	—	—	—	—	—	—	—	+	+	+	+	+	+	+	+
	2	+	+	+	+	+	+	+	—	—	—	—	—	—	—	—
	3	+	+	+	+	+	+	+	—	—	—	—	—	—	—	—
	4	+	+	+	+	+	+	+	—	—	—	—	—	—	—	—
	5	+	+	+	+	+	+	+	—	—	—	—	—	—	—	—
	7	+	+	+	+	+	+	+	—	—	—	—	—	—	—	—
	13	+	+	+	+	+	+	+	—	—	—	—	—	—	—	—
	14	+	+	+	+	+	+	+	—	—	—	—	—	—	—	—
	15	+	+	+	+	+	+	+	—	—	—	—	—	—	—	—

but not intracompatible. As regards the genetical explanation of this type of sex in Hymenomycetes it is a well accepted fact that a single allelomorphic pair of factors (Aa) are present in the synkaryon of the basidium. The two factors (A) and (a) are present in the same locus on different chromosomes. During meiosis the two factors disjoin and segregate equally so that two of the tetratype nuclei receive one kind of factor (A) and the other two nuclei receive the opposite factor (a). Thus, in each spore only one factor (A or a) is present. Mycelia developed from these spores have the same genetic constitution and will contain either the factor (A) or (a) and are eventually of two types which are sexually different.

Incidentally, few macroscopically visible reactions have been recorded which are as follows:—

Compatible.—The two monosporous mycelia intermingle to form a perfect homogeneous mat which superficially looks like the typical polyporous culture. Abundant clamp-connexions indicate that copulation has taken place.

Neutral.—The two monosporous mycelia intermingle to form a homogeneous mat but the resulting mycelium with clamp-connexions is not produced. In some cases a narrow line

of condensed hyphae is visible in the region of apparent intermingling of the testing pair. In other cases the two reacting mycelia do not intermingle and leave a narrow somewhat wavy line separating the two mycelia at the point of contact.

Irrespective of the above visually recognizable types of reaction, the presence or absence of the clamp-connexions has been considered as the sole basis in determining the polarity and sex-groups present in *D. flavida*. No importance, has been laid on these reactions particularly on some neutral types which apparently seems to be 'antagonistic'. But this cannot be homologous with what Kaufert (1936) called 'antagonism', because the fungus (*Pleurotus corticatus* Fr.) he studied was a 'tetrapolar' species and the fungus under consideration is a 'bipolar' one according to the present compatibility test.

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A NOTE ON THE INHERITANCE OF HEIGHT IN SORGHUM

SORGHUM varieties range in height from 2 to 15 feet. The inheritance of this character was studied in India and U.S.A. to a great extent. In this paper, the experiences recorded on the inheritance of height in a cross between Bonganhilo (*Sorghum caudatum*, Stapf AS. 4003) and *Pyrus Jonna* (*S. durra*, Stapf, G. 2 *Jonna*) are reported.

Tallness was reported to be dominant by Karper (1932). Sieglinger (1932) also reported a single factor segregation of three tall to one dwarf in broom corn. Ayyangar et al. (1937) reported "short-early" as dominant over "tall-late". In this case segregation for internodes was reported and not for a gene that influences elongation of internodes. Quinby and Karper (1954) reported tallness as partially dominant.

At the Agricultural Research Station, Lam, crosses were made between G. 2 *Jonna* and AS. 4003. The behaviour of the progenies with reference to height is reported below.

TABLE I

Variety	Group	No. of plants	Average height in cm.	Range of height in cm.	S.E.
G. 2 <i>Jonna</i> ..	Tall	25	161	150-168	0.91
AS. 4003 ..	Short	25	102	96-114	1.14
F.1 hybrid ..	Medium	18	140	123-160	2.7

It is seen from the above data that the F. 1 hybrids were of medium height. In the F. 2 generation, 160 plants of medium height and 58 short plants were obtained conforming to the 3 : 1 ratio.

	No. of medium height plants	Average height	No. of short plants	Average height
F.2 generation (observed)	160	130	58	101
Calculated on 3 : 1 ratio ..	163.5	..	54.5	..

$$X^2 = 0.29; P = 0.5.$$

The above data show that the character tallness is partially dominant.

As already pointed out, Ayyangar (1937) reported segregation for two types of internodal disposition. In the "short-early" plants there were on an average 10.6 internodes with *Unimodal* disposition and in the "tall-late" plants there were 16.7 internodes with *bi-modal* disposition. The "short-early" plants were reported to be dominant over "tall-late" plants. In₁ produces "short-early" plants with *Unimodal* disposition of internodes. in₁ gives rise to plants that are "tall-late" with a greater number of internodes and their *bi-modal* distribution.

Taking this into consideration the internodal lengths and disposition were examined in both G. 2 *Jonna* and AS. 4003 and the data are given in Table II.

Ayyangar et al. (1938) described three types of internodes in *Jonna*, viz., *Uniform increase*, *Unimodal* and *bi-modal*. According to this, the internodal disposition is of *Uniform increase* type in G. 2 *Jonna* and *Unimodal* in AS. 4003. The F. 1 hybrids possessed plants with *Uniform increase* inter-nodal disposition, revealing the dominant nature of this character over *Unimodal* type. In the F. 2 generation, plants with longer and *Uniform increase* internodes produced tall plants while plants with short and *Unimodal*

TABLE II

Variety	Length of internodes in cm.											Mean No. of internodes
	1	2	3	4	5	6	7	8	9	10	11	
G.2 Jonna ..	1.4	5.5	12.3	16.3	18.1	19.7	21.6	21.8	23.0	..	..	8.0
AS. 403 ..	1.2	3.4	5.0	8.5	9.9	11.2	11.1	10.3	10.8	10.6	9.5	10.3
F.1 hybrid ..	1.7	7.0	12.1	17.7	20.3	21.3	21.4	21.5	21.8	..	..	8.5

internodes produced short plants. These preliminary studies on height and internodes reveal that (i) tallness is partially dominant, (ii) *Unimodal increase* type of internodal disposition is dominant over *Unimodal* type, and (iii) the height in *Jonna* depends upon the length and number of internodes.

My thanks are due to Sri. S. Ramachandrarao, Millet Specialist, Andhra Pradesh, for the valuable suggestions offered in preparing this note. Agricultural Research Station, C. SREERAMULU. Lam A.R.S., P.O., Guntur-2, May 19, 1959.

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LEAF-SPOT OF ROSE CAUSED BY *CURVULARIA LUNATA* (WAKKER) BOEDIJN

A LEAF-SPOT disease of garden rose though not of very serious nature was commonly found at Sabour in the months of July to November in the last three years. Careful examination of the infected leaflets revealed isolated, irregular, light brown spots on the leaf surface. The spots increased in size, affected leaflets turned yellow, then started drying up and in some cases were finally shed off.

Microscopic examination of the scrapings of the spots revealed the presence of brown and mostly 4-celled conidia and cultural studies proved this to be those of *Curvularia*. Platings of the surface sterilized (in mercuric chloride, 1:1000) infected leaves of rose on potato-dextrose agar medium yielded the fungus with the colour of the mycelial colony changing from white to greenish dark. Copious conidial formation took place in 5-7 days. Intercalary thick-walled Chlamydospores were found in many cultures.

Pathogenicity tests conducted with a single spore culture of the fungus gave positive results.

So far, in India, *Curvularia* has not been reported on rose.¹⁻³

The morphological and pathological characters of the fungus are described below:—

Mycelium septate, hyaline to greenish brown; Conidiophores rigid, straight or bent, 2-9-septa, olive brown, 123-205 × 4.1-6.15 μ broad. Conidia clavate, pear-shaped or elongate, straight or bent, thick-walled, 3-septate, olive-brown, third cell from base broader and darker and constriction at septa not prominent. Conidia from cultures were 24.3 × 10.7 (18-28 × 9-13) μ. Pathogenicity tests were attempted by the standard technique on rose, young and older leaves of *bajra* and on the male inflorescence of maize. Inoculations on rose only were successful.

The morphological and cultural characters indicate that the fungus isolated from rose is *Curvularia lunata*.⁴⁻⁶

The authors are grateful to Dr. B. L. Chona, Systematic Mycologist, I.A.R.I., New Delhi, for his help in identification of the fungus and to Dr. R. H. Richharia and Prof. N. B. Syamal for providing all facilities.

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PARTHENOCARPY IN GUAVA INDUCED BY 'POLLEN HORMONE'

Most of the naturally formed seedless or parthenocarpic fruits are produced either without pollination or pollination without fertilization. In the case of pollination without fertilization, it has been reported in some orchids, cucumber, solanaceous plants, etc., that

the development of parthenocarpic fruits is due to some chemical present in the pollen grains, otherwise known as 'pollen hormone'.¹⁻⁴ In our studies on the floral biology and fruit-set of three varieties of guava (*Psidium guajava* L.) certain interesting observations on the development of the ovary without fertilization were made and the results are reported here.

Three-year old guava plants of the varieties, 'Allahabad Round', 'Chittidar' and 'Lucknow' in the Annamalai University Experimental Orchard were selected for the studies. When the flowers were emasculated in the usual manner and self-pollinated artificially it was found that in all the three cases there was fruit-set. In the absence of pollination, i.e., when the flowers were bagged soon after emasculation, there was no fruit development. The fruits developing from the self-pollinated ovaries of 'Chittidar' and 'Lucknow' were profusely seeded, whereas the ones in 'Allahabad Round' were completely seedless.

With a view to examine the details of the fertilization process, pollen grains from the flowers of the three varieties were collected immediately after, or just prior to, their opening and they were tested for viability. The grains were first placed in various concentrations of aqueous glucose ranging from 2 to 10%. It was found that the maximum percentage of germination of the pollen grains of 'Lucknow' and 'Chittidar' was obtained in 6% glucose solution. But the pollen grains of 'Allahabad Round' failed to germinate in any of the concentrations tested, except for minute protrusions of the exine through the germ pore, which failed to develop into normal germ tube even after 48 hours. The length of protrusions reached a maximum of 22.5μ in 'Allahabad Round' as against over 200μ of germ tubes in the other two varieties. Subsequently, the pollen from the latter variety was tested for germination in 15, 20 and 25% cane-sugar solutions and there was no germination in any case.

The germination under natural conditions of the pollen grains of three varieties was also examined by artificially applying the grains to the stigma of the emasculated flowers at different intervals, before and after their opening. It was found that in the case of 'Chittidar' and 'Lucknow', when applied two hours after the opening of flowers, there was normal development of pollen tube indicating thereby that the stigma is receptive only around that period. In the case of 'Allahabad Round' no germination or protrusion of the pollen could be observed in any of the treatments.

In order to examine whether there was any 'pollen hormone' effect in the case of 'Allahabad Round', the grains were collected from the flowers immediately after opening and crushed thoroughly in a pestle and mortar with the addition of small quantities of distilled water. The resulting paste was examined under the microscope and found that none of the pollen grains were intact. The paste was then diluted in distilled water, filtered through muslin cloth and the filtrate was applied to the stigma of emasculated flowers and were bagged in the usual manner. Fifteen flowers were treated in similar way and observations made on the development of fruits. It was observed that in all the 15 cases the ovary had developed into seedless fruits and when they were cut open it was found that there was a central round cavity coated with brownish powdery aborted ovules (Fig. 1).

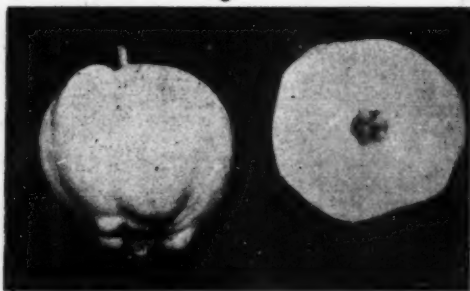


FIG. 1. 'Allahabad Round' fruit with transverse section showing the characters of parthenocarpy.

The parthenocarpic fruits are characterised by 6 to 8 prominent ridges on the surface and swellings in the calyx-end, corresponding to the ridges. The fruits take nearly a month longer to mature as against $3\frac{1}{2}$ to 4 months in the seeded fruits. The fruit pulp is also more granular and tasty than the seeded ones of the same variety.

In order to study the compatibility of foreign pollen grains with 'Allahabad Round', the grains from 'Chittidar' and 'Lucknow' were used for pollinating the emasculated 'Allahabad Round' flowers and vice versa. It was found that the pollen from 'Chittidar' and 'Lucknow' fertilized the ovary of 'Allahabad Round' giving rise to fruits with 10 to 12 seeds per fruit; the pollen grains of 'Allahabad Round' failed to fertilize the ovaries of the other two varieties and also

there was no parthenocarpic development of the fruits.

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EFFECT OF CERTAIN ORGANIC INSECTICIDES ON THE YIELD OF WHEAT CROP

BESIDES the role of controlling the insect pests the insecticides also have other effects on the plants, viz., they may prove beneficial and give better yields or otherwise. Very recently

The data of the yield of wheat crop are tabulated in Table I.

In the trials (Table I) 0.25% DDT and 0.04% Folidol have resulted in increased yields as compared to the 'control' (being 1 lb. 8 oz. and 14 oz. over the control). The poorest performances were, however, given by 0.05% Endrin and 0.15% DDT followed by 0.03% Folidol and 0.075% Endrin, and 0.20% DDT. 0.02% Folidol and 0.10% Endrin. The above results are based on the observations of one year.

Thanks are due to Shri R. B. Gupta and Shri S. P. Acharya for carrying out the treatments.

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TABLE I

Treatment	Replication I		Replication II		Replication III		Total of three replications		Variation from control	
	lb.	oz.	lb.	oz.	lb.	oz.	lb.	oz.	lb.	oz.
1 0.15% DDT	7	6	6	4	8	0	21	10	-3	6
2 0.20% do.	7	12	8	12	7	12	24	4	-0	12
3 0.25% do.	8	4	10	0	8	4	26	8	+1	8
4 0.02% Folidol	7	2	8	0	9	4	24	6	-0	10
5 0.03% do.	7	12	8	8	6	4	22	8	-2	8
6 0.04% do.	9	2	7	14	8	14	21	14	+0	14
7 0.05% Endrin	9	4	4	8	6	12	20	8	-4	8
8 0.075% do.	8	0	7	4	8	6	23	10	-1	6
9 0.10% do.	7	12	8	4	8	8	24	8	-0	8
10 'Control'	8	14	8	8	8	10	25	0	..	..

Seshagiri Rao (1959) has conducted some trials on potato, groundnut, cabbage and garden beans concluding his results on the yields. The knowledge of the effect of insecticides on the yield of crops is of great value in facilitating their economic use.

Field trials were undertaken to assess the effect of different doses of DDT, Folidol and Endrin on the yield of wheat crop (variety C. 281). The crop was sown on 30-10-1958 in 30 plots of 20' x 20' size and harvested on 3-4-1959. The insecticides were sprayed twice, in three replications, at an interval of two months, first in the second week of December 1958, and next in the second week of February 1959. So far as the insect infestation is concerned, only a negligible incidence of the stem borer (*Sesamia inferens* Wlk.) was recorded.

CHAETOTAXY OF THE SOLDIER, WORKER AND ALATE OF THE TERMITE *ODONTOTERMES OBESUS* (RAMBUR)

THE study of chaetotaxy has been found to be of considerable use in taxonomic differentiation between species of higher groups in insects, particularly the Diptera adults, Lepidoptera larvae, etc. No such study seems to have been made so far for the Isoptera. As a first step, the chaetotaxy in the common mound-building termite, *Odontotermes obesus* (Rambur) (Isoptera, family Termitidae) was studied.

About 25 specimens of each caste, viz., the soldier, worker and alate, were studied and the percentage of occurrence of bilaterally symmetrical bristles calculated. The arrangement of

bristles resembles each other closely in workers and alates in the head region, and in soldiers and workers in the thoracic and abdominal regions. A nomenclature in Arabic numerals has been used for the labral bristles, but in

most other cases the bristles have been named according to their location on the body-part. The characteristic bristles observed in more than 80% of the individuals of the three castes are summarised in Table I.

TABLE I
The more important setae and bristles in *Odontotermes obesus*
N.B.—All the bristles are paired, except those mentioned otherwise

Body-regions and appendages	Nomenclature of the bristles	Frequency percentage of bilateral symmetry		
		Soldier	Worker	Alate
	I—Head capsule (Dorsal)			
Clypeus	Clypeal	100	96	..
Frons	Frontal	100	92	..
Epicranial region	{ Epicranial 1	92	..	..
	{ Epicranial 3	88	..	..
	{ Epicranial 4	98	..	..
Genae	{ Medio-genal	96	..	..
	{ Proximo-genal	88	..	..
	II—Head-appendages			
Labrum	{ Apical	100	100	96
	{ Apical lateral	..	100	96
	{ 1	100	100	88
	{ 2	97.5	100	84
	{ 3	95	100	96
	{ 4	95	92	96
	{ 5	..	..	96
Galea	Disto-galeal	92	..	..
Glossa	Medio-glossal	..	88	..
Prementum	Premental 1	..	100	..
Postmentum	{ Postmental 1	92	92	100
	{ Postmental 2	..	92	80
	{ Postmental 3	..	84	..
	{ Medio-postmental	96	100	..
	III—Thorax			
Prothorax	{ Pronoto-anterior	100	100	..
	{ Pronoto-lateral	96	88	..
	{ Pronoto-posterior	100	92	..
Mesothorax	{ Mesonoto-lateral	96	84	..
	{ Mesonoto-posterior	96	..	..
Metathorax	{ Metanoto-lateral	100	88	..
	{ Metanoto-posterior	96	..	..
	IV—Legs			
Fore-leg	Dorsal tibial spur (single)	100	100	100
Fore-leg	Ventral tibial spurs	100	100	100
Middle-leg				
Hind leg				
	V—Abdomen			
Sternite 1	Sterno-posteromedial	..	100	..
Sternite 2	Ditto	100	100	..
Sternite 3	Ditto	100	100	..
Sternite 4	Ditto	100	100	..
Sternite 5	Ditto	100	100	..
Sternite 6	{ Sterno-posterosublateral	..	80	..
	{ Sterno-posteromedial	100	100	..
	{ Sterno-posterosublateral	80	95	..
Sternite 7	{ Sterno-posteromedial	100	100	..
	{ Sterno-posterosublateral	95	100	..
	{ Sterno-posteromedial	100	100	..
Sternite 8	{ Sterno-posterosublateral	80	90	..
	{ Sterno-posteromedial	..	100	..
	{ Sterno-posterosublateral	..	90	..
Sternite 9	Cercal (3 bristles)	84	..	..
Cerci	Stylar 1	100	100	..
Sabanal styles	Stylar 2	96	96	..

For the external morphology of this species vide Kushwaha.^{1,2}

My sincere thanks are due to Dr. M. L. Roonwal, Director, Zoological Survey of India, Calcutta, for his guidance and supervision during the progress of the work and for laboratory facilities at the Forest Research Institute, Dehra Dun, and the Zoological Survey of India, Calcutta.

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FIELD EVALUATION OF SOME ORGANIC PHOSPHATES FOR THE CONTROL OF THE ONION THIRPS, *THRIPS TABACI* LIND. THYSANOPTERA : THIRIPITIDAE

The onion thrips, *Thrips tabaci* (Lind.) maintains its continuous breeding in the field throughout the year on Brinjal, Onion, Garlic, Bhindi, Cotton, Bottlegourd, Hollyhocks and Sunflower and causes considerable damage to the Onion and Garlic crops each year. With a view to develop a suitable chemical control of the pest, the screening tests with four organic phosphates (Folidol, Diazinon, Malathion and Metasystox) at four levels of concentration (0.01%, 0.025%, 0.03% and 0.04%) were carried out in the year 1957. In the light of the results of the screening tests, a pilot field trial with the same insecticides at one level of concentration (0.025%) was conducted in the experimental area during the year 1958. The trial included five treatments and each one was replicated four times. The size of the micro-plots was 3' x 3' and the spacing between plant

to plant and row to row was kept as 6". The initial infestation of the thrips under each replicate was estimated before starting the treatments. The population was estimated on the basis of the sample size of five leaves harvested at random and counting the number of thrips present on the leaf-samples. At the time of each observation, four leaf-samples were collected from each replicate. The performances of different insecticides after 1 day, 6 days, 12 days, 18 days and 24 days were recorded.

The data collected on the performances of different treatments are summarised in Table I. The data clearly indicate the superiority of Folidol over other treatments. The Folidol (0.025%) gave the immediate knockdown of the thrips one day after spray and its residual toxicity persisted for 12 days after the treatment.

Folidol not only gave the best performance in keeping down the thrips infestation but also improved the growth condition of the plants. No such reaction was observed in case of Metasystox. No record on the thrips population was maintained after 24 days since there was a considerable decline in the residual toxicities of the insecticides. According to Israel and Vedamurthy (1954) and Padmanabhan and Israel (1956) Folidol (0.04%) gave excellent control of the paddy stem borer.

The emulsifier incorporated in Folidol seems to maintain the toxicity of the compound when used at low concentration. The improved growth condition of plants, as observed under Folidol treatment, indicates that the organic phosphate (Folidol) used in the experiment might have been converted into available phosphates and they were in turn utilized by the plants for good growth condition. Such reactions in plants are clearly demonstrated by Fukuto and his associates (1955) and Lall *et al.* (1958) in relation to Systox.

The authors wish to express their gratitude to Dr. R. H. Richharia, Principal, for providing

TABLE I
Comparative efficacy of organic phosphates against the Onion thrips

Insecticides		Percentage dosage	Av. initial infestation per leaf	Percentage population reduction after days					Average total reduction
				1	6	12	18	24	
Folidol	..	0.025	5.785	94.04	87.25	85.99	75.52	38.85	76.33
Diazinon	..	0.025	6.435	43.35	49.08	76.55	66.30	40.41	55.14
Malathion	..	0.025	7.620	35.51	25.09	62.65	45.58	23.25	38.61
Metasystox	..	0.025	7.835	28.01	18.53	68.47	52.92	21.79	37.94
Control	..	..	8.54	9.56	9.90	16.25	11.74	11.68	..

necessary facilities in the Post-graduate Laboratory for carrying out the investigations.

Divn. of Entomology, B. S. LALL.
Bihar Agric. College, Sabour, S. K. VERMA.
May 4, 1959.

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TRANSMISSION OF CITRUS DECLINE VIRUS BY *TOXOPTERA CITRICIDUS* KIRK. IN INDIA

THE tristeza quick decline virus disease of citrus is now recognised to be of major economic importance in principal citrus-growing regions of the world. The virus nature of this disease was experimentally demonstrated in 1946 by Meneghini,¹ who successfully transmitted tristeza in Argentina through a species of black aphid—*Aphis citricidus* (Kirk.) (Synonym of *Aphis tavaresii* De Guercio and *A. citricola* Van der Goot.). In the same year Fawcett and Wallace,² later Wallace and Fawcett,³ reported transmission of quick decline in California through budding and grafting. Transmission of tristeza through *Aphis citricidus* was further confirmed by Bennett & Costa⁴ and McClean.⁵ Dickson *et al.*⁶ demonstrated the transmission of quick decline virus in Florida through *Aphis gossypii* Glover. Norman and Grants^{7,8} showed that the virus was transmitted also by *Aphis spiraeicola* Patch and *Aphis gossypii* Glover, respectively.

Knorr⁹ showed that in addition to the Key lime plants which had been employed as a differential host of tristeza virus in many places, *Aeglopsis chevalieri* Swing., could also be used as a useful indicator host. Vasudeva and Capoor¹⁰ first demonstrated the presence of the virus in this country through budding and grafting.

Survey of the citrus aphids at Poona, in 1958, revealed the presence of *Toxoptera citricidus*, Kirk., colonising from November to March on all species of citrus. In the first instance, aphids breeding on diseased plants of Mosambi (*Citrus sinensis* var. Mosambi), Grape fruit (*Citrus paradisi* Macf.), Kagzi lime (*Citrus aurantifolia* Swing.) and citron (*Citrus medica* var. acid), were collected and liberated directly on Key lime seedlings raised from seed. In another set of experiments aphids were bred on healthy Key lime plants in an insect proof

glass-house and fed for 24 hours on young twigs from diseased Kagzi lime, grape fruit, and citron plants and then liberated on Key lime seedling for 12 hours. Characteristic vein-clearing symptoms indicating the presence of tristeza developed in Key lime after 40 to 100 days following inoculation in both the experiments. The symptoms faded away as the plants grew older.

In addition, two *Aeglopsis* seedlings were inoculated by first feeding the aphids on diseased Mosambi plants (Mosambi on sour orange root stock from experiments reported by Vasudeva and Capoor¹⁰) for 24 hours and then liberating them on test seedlings for 12 hours. Both the plants developed typical vein-clearing symptoms (Fig. 1) similar to those

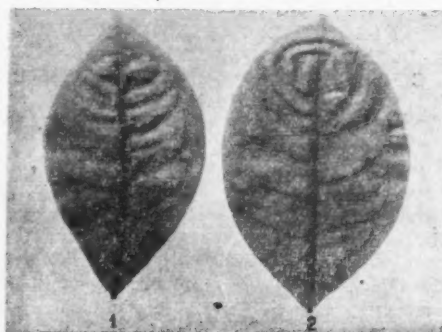


FIG. 1. *Aeglopsis chevalieri* leaves. (1) Healthy; (2) From Mosambi.

reported by Knorr.⁹ This indicated that the virus present on Mosambi was similar to the strain of virus present in Argentina.

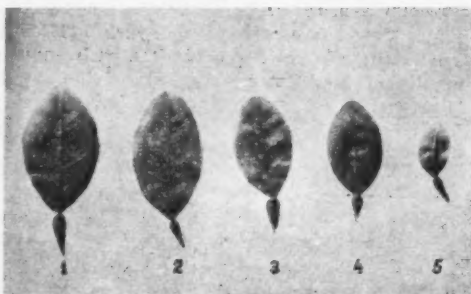


FIG. 2. Kagzi lime leaves. (1) Healthy; (2) From citron; (3) From Kagzi lime; (4) From Mosambi; (5) From late Valencia orange.

Further, young Kagzi lime plants were similarly inoculated with aphids fed on diseased

cilron, Kagzi lime, Mosambi and late Velentia orange plants. The test seedlings showed typical vein-clearing in 40 to 65 days (Fig. 2) similar to the symptoms of disease observed in Kagzi lime seedlings following inoculation through budding and grafting.¹¹ Kagzi lime has not been reported previously as an indicator host for this virus.

The experiments reported above clearly show that the tristeza or quick decline virus in India is disseminated in nature through the agency of the aphid *Toroptera citricidus* Kirk.

Division of Mycology and R. S. VASUDEVA.
Plant Pathology, P. M. VARMA.
Indian Agri. Research Inst., D. G. RAO.
New Delhi, June 16, 1959.

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**MOGHANIA MACROPHYLLA (WILLD).
O. KTZE. (SYN. FLEMINGIA CONGESTA
ROXB. VAR. SEMIALATA BAK.) AS A
NEW LAC HOST FOR GROWING THE
KUSMI STRAIN OF THE LAC INSECT**

Moghania macrophylla (Fam.: Leguminosae; subfam.: Papilionate) is a tall, erect shrub growing to a height of 8'-10' with sulcate silky branches. It is widely distributed in the Himalayan and Sub-Himalayan forests from Chamba to Bhutan, Khasi and Naga hills in Assam, the hills of Parasnath and Visakhapatnam and along the Western Ghats in South India, up to a height of 5,000 ft. It is known to be one of the important minor lac hosts in Assam, chiefly in Mikir hills, for growing the *Rangeeni* strain of the lac insect. Of late, however, the use of this host for lac growing is being gradually discontinued in those areas.

Recently at the Indian Lac Research Institute, Namkum, research work on the possible utilisation of this as also of some other natural bushes and shrubs for lac cultivation has been undertaken with the object of introducing intensive cultivation of lac under agricultural

conditions and thereby reducing the cost of production of lac. One important advantage of working with this type of host is that cultivation of lac can be carried out in limited areas on a concentrated scale and climbing of trees either for inoculation or for cropping is avoided, which considerably reduces the cost of cultivation. Work has been carried out with *M. macrophylla* in particular, along two directions, namely, raising a plantation of these and their subsequent inoculation for lac growing. Results indicate that *M. macrophylla* shrub can be successfully raised through direct sowing of the seeds at a spacing of 6' x 6'. The shrub is ready for lac inoculation in about 2 years' time and regular lac cultivation thereafter leads to profuse tillering accompanied with a gradual increase in the size of the stool to 2' x 2'. These plants coppice well and it appears that the plants once raised can continue to serve as lac hosts for many years to come. At Namkum, the plants raised as early as 1952, yet continue to grow satisfactorily and give adequate yields of lac crops since their first inoculation in 1954.

Crop data obtained since then work out to an average yield of 3.6 (maximum variation 1.4-6.5) times the quantity of brood lac used, in the case of the *Katki* (June-July to October-November) crop, and to 2.3 times the quantity of brood used in the case of the *Baisakhi* (October-November to June-July) crop.

Recently investigations have also been taken up for growing Kusmi lac on this host by inoculating it with the Kusmi strain of the lac insects. Results obtained in the last two seasons indicate that this host has great potentiality as an alternative host for the Kusmi tree (*Schleichera oleosa*). Successful crops can be grown on it particularly in the Aghani (June-July to January-February) seasons, the yield obtained being as much as 2 times the amount of brood used for inoculation. The progenies raised on this host with the Kusmi strain have continued to breed true for the three successive generations both morphologically and in durations of life-cycles. The colour of the resin obtained also is superior to that of the *Rangeeni* lac and conforms to that of the usual type of Kusmi lac.

However, this species being a natural shrub, is not able to support large numbers of lac insects during summer and hence the summer crop (*Baisakhi* or *Jethui*) is not quite satisfactory, but with irrigation fairly satisfactory crops and brood yields may be obtained even during the summer. Its performance in the rainy season (namely, *Katki* and *Aghani* seasons) however, is quite good, and yields of lac sticks

up to a pound per plant can be obtained, using 3 to 4 oz. of brood lac for inoculation.

In view of the great demand from the consuming countries for better quality lac like that from the Kusmi strain, the utilization of this species as an alternative to the Kusum tree particularly for raising Aghani crops merits serious consideration. Further work is in progress to see how far this great promise based on our preliminary trials could be fulfilled in toto.

Indian Lac Research
Institute,
Namkum,
May 13, 1959.

S. KRISHNASWAMI.
B. K. PURKAYASTHA.
N. S. CHAUHAN.

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DIFFERENTIAL RESPONSE OF WHEAT VARIETIES TO N.P.K. AND THEIR COMBINATIONS

It is generally known that improved varieties of rice and wheat bred for high yield, resistance to common diseases and pests, differ amongst themselves in their nutritional requirements. Therefore when any improved variety is provided, it is necessary that its manurial requirement should also be known.

During the course of investigations carried out in Rabi 1957-58 at the Indian Agricultural Research Institute Farm, it was observed that among the two wheat varieties selected for study, N.P. 718 was found to be high yielding variety compared to N.P. 710 though the difference was not statistically significant. Out of three major plant nutrients, phosphate manuring increased the crop yield significantly. In case of N.P. 710, application of 20 and 40 lb. P_2O_5 /acre increased grain yield by 3.14 and 4.43 mds. while the corresponding increases in case of N.P. 718 were 3.19 and 4.32 mds. respectively. This indicated that the phosphatic requirement of both the varieties was almost of the same order. It was further observed that the variety N.P. 718 gave better response to levels of nitrogen than N.P. 710. Application of 20 lb. K_2O /acre reduced grain yield by 0.39 mds. in N.P. 710 and 0.67 mds. in N.P. 718 while 40 lb. K_2O /acre increased yield of N.P. 710 and N.P. 718 by 1.19 and 0.29 mds./acre respectively. This showed that N.P. 710 required more potash than N.P. 718. Beneficial effects on growth observations due to application of nitrogenous fertilizer was pronounced during 60-70 days

period while phosphate fertilizers gave highest increase during 75-90 days after sowing. Effect of potash was prominent during early tillering stage.

Division of Agronomy, M. M. P. SHRIVASTAVA.
Ind. Agri. Res. Inst.,
New Delhi-12, August 22, 1959.

NYCTOCEREUS SERPENTINUS Br. et R.—CEREUS SERPENTINUS D.C.

A CUTTING of the above cactus was planted in a ten-inch pot about ten years ago and placed near the wall of the courtyard. It slowly spread out and came in contact with the wall. The shoots formed branched adventitious roots and stuck to the plaster of the wall (Fig. 2). Some of these roots are over one foot in length.



FIGS. 1 and 2.

During the course of about ten years, the plant has occupied the wall area—12' x 8' (Fig. 1) and would have spread more had there been room and also had the original shoot been planted in the ground instead of in the pot. The roots, supporting the plant, have formed a thick mat stuck to the wall. It flowers in May-June and the flowers are about five inches long, funnel-shaped and white.

Economic Botanist (Retd.), T. S. SARNIS.
Govt. of U.P.,
Kanpur, August 21, 1959.

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REVIEWS

Electricity, Magnetism and Atomic Physics. (Vol. II). *Atomic Physics*. By J. Yarwood. (University Tutorial Press Ltd., Clifton House, Euston Road, London N.W.1; India: Oxford University Press, Madras-2), 1958. Pp. viii + 644. Price 40 sh.

The present volume is a concise and at the same time a comprehensive text-book on Modern Physics dealing with the fundamentals of the study of electrons, ions, atomic structure and atomic radiations. As a companion to the earlier volume on classical Electricity and Magnetism, it is but natural that the historical development of the subject should be kept in view. Thus the classical quantum treatment of atoms and atomic spectra are dealt with in detail while the more fruitful method of wave-mechanics is confined to a single chapter which gives the main principles of this approach.

The book is divided into two almost equal halves, the first ten chapters being devoted to extranuclear phenomena and the remaining eleven chapters to radioactivity and nuclear phenomena including cosmic rays.

The book is up-to-date and includes latest topics which have been fairly well established in physical theories and as such should find an accepted place in a modern text-book.

The chapter on Nuclear reactors is particularly instructive and besides dealing with the principles involved in thermal reactors, it also gives brief details of the reactor at the Calder Hall Power Station.

The book is interspersed with worked examples and at the end of each chapter there are exercises and questions mostly taken from University papers. The sequence of treatment and the clarity of expression show that the book is written by an experienced teacher who is keenly aware of the needs and difficulties of examination-going students. The book will form an adequate text-book on Modern Physics for Honours and Degree students with Physics as the major.

The reviewer in his perusal of the book noticed a small error on p. 122, line 3 from bottom where 'm' in the equation is redundant.

The printing is bold and clear and the get-up is good.

A. S. G.

Structure Reports. Vol. XIV. General Editor. A. J. C. Wilson. (International Union of Crystallography), Pp. 215. Price. \$ 9.50.

The present volume represents, in the main, the cumulative index of structure reports for the years 1940 to 1950. The subject and author index are arranged alphabetically. In the formula index, the constituents are arranged in the alphabetical order of the chemical symbols. An additional index for carbon compounds is included, in which the primary classification is by the number of carbon atoms and the secondary classification is by the number of hydrogen atoms. A cumulative index for metals appears separately. A corrigenda for Volumes 8-130 appears at the end. The volume also contains a few actual structure reports. It may sound superfluous to elaborate on the usefulness of a cumulative index provided such an index has been compiled with care and forethought, as has been done in the present volume.

A. J.

Principles of Electronics. Second Edition. By H. Buckingham and E. M. Price. (Cleaver-Hume Press Ltd., London), 1958. Price 17 sh. 6 d.

This book, the ninth in the Cleaver-Hume Electrical Series, has a two-fold objective: to survey the fundamental processes of electronics and the theory and uses of the common electronic devices, and to describe the role of electronic apparatus and methods in engineering and industrial problems.

The first part of the book, after discussing atomic structure, radiation, electron emission, electron beams and semiconductor phenomena, describes the characteristics of vacuum and gas tubes, photo-electric tubes and cathode ray tubes, and traces the evolution of special purpose tubes such as the disc seal triode, the magnetron and the Klystron and the family of television camera tubes. The latter part of the book gives an exposition of the general principles of rectification, amplification, modulation and detection. Then follow a series of chapters dealing with practical applications: the use of photocells in illumination problems, in measurement and in industrial control; induction and dielectric heating; electric

welding; motor controls and register controls; measuring devices; electronic counters; proximity detectors; particle accelerators; and the electron microscope.

Mindful of recent progress in the subject, this second edition introduces two chapters dealing with magnetic amplifiers and transducers and junction rectifiers and transistors. In the interests of brevity, the explanations are somewhat oversimplified, but enough is said to arouse the curiosity of the reader and bring him an awareness of the many-sided advances that are taking place.

The book, though lucidly written, is not detailed enough to be prescribed for students in electronic engineering. But the material it presents will interest and greatly aid those to whom it is addressed, namely, students in electrical and other branches of engineering that have begun the use, on an increasing scale, of electronic methods and devices.

S. SAMPATH.

Indian Ephemeris and Nautical Almanac, 1960.

(Published by the Manager of Publications, Civil Lines, Delhi). Pp. xxvii + 444. Price Rs. 14-00 or 22 sh.

The present issue of the Ephemeris for 1960 is a definite improvement over the first two issues for 1958 and 1959, and it is gratifying to note that in the preparation of this issue due attention has been paid to the most important shifts in international practice regarding the preparation of allied publications. Such an outstanding change introduced in this year's issue is the use of Ephemeris Time instead of Universal Time for the indication of the positions of the sun, moon and the planets. The short account given in the Introduction explaining the genesis of this change is very clear and convincing. Further improvements consist in the addition of ten new tables indicated on pp. v and vi of the Preface, accompanied by suitable explanations relating to them.

The section relating to the Indian Calendar has also been enriched by the addition of an extra table on pp. 420-21 giving the longitudes of the sun, moon and the planets for the period 1st January to 22nd March, 1961, in order to facilitate the preparation of Indian Panchangas for one complete Indian year. In this connection, one would naturally raise the question as to how far the publication of the Indian Ephemeris and Almanac for the last three years has helped in improving the accuracy of the several indigenous almanacs in the

country. We regret to say, however, that such an influence has been little or negligible as shown by the fact that many such almanacs in vogue in several parts of the country, which we recently had an occasion to see, are still hopelessly inaccurate even as regards fundamental data. It is, of course, unfair to expect the publishers of the Indian Ephemeris to undertake the task of reforming our indigenous almanacs, but it is desirable that an agency should be set up to undertake the introduction of these reforms.

A short review like this is not the proper place where one could indicate in detail the several improvements introduced in the present publication. It is nevertheless true that there are plenty of such improvements, and, in particular, the get-up, and the printing of the several tables are very well done. We hope that this excellent publication will be more widely used hereafter, and will serve as an incentive to the development of Indian Astronomy specially on the observational side.

B. S. MADHAVA RAO.

Chemical Analysis. Vol. III. (*Colorimetric Determination of Traces of Metals*.) Third Edition, Revised and Enlarged. By E. B. Sandell. (Interscience Publishers, Inc., New York-1), 1959. Pp. xxii + 1032. Price \$24.00.

Colorimetric methods for the determination of metal traces have found so many new applications and are so universally practised that an up-to-date survey of the subject as has been attempted in this volume is most welcome. This volume is divided into two parts, the first of which deals with the general aspects of inorganic trace analysis in a very readable manner while the second describes succinctly the procedures for 48 elements and the rare-earths.

This book will be read with great interest and profit both by the beginner as well as by the advanced research worker and the professional analyst. The presentation of the subject-matter and the get-up are excellent but the price is rather high.

K. R. K.

Biochemical Society Symposia No. 16—The Structure and Function of Subcellular Components. (University Press, Cambridge, U.K.), 1959. Pp. 100. Price 15 sh. (Paper bound.)

The structure and function of Subcellular components edited by E. M. Crook (Cambridge

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University Press, 1959) contains several important contributions summarising the prevalent concepts about the ultrastructure of cell membranes and the properties of the cell membranes with reference to transport of metabolites. In particular, the article by J. D. Robertson presents a fairly comprehensive compilation of the more recent developments in the field of cell membrane structure and is very stimulative, emphasising as it does, the somewhat speculative hypothesis that several cells have double membranes elegantly discernible by electron microscopy. Though the conclusions presented are largely derived from a detailed study of unmyelinated nerve fibres, they are probably of a more general significance, and suggest several lines of further investigation. The large number of diagrammatic representations and photomicrographs are very valuable. This is followed by an interesting article by S. J. Holt on the application of some promising cytochemical staining reactions for the study of intracellular enzyme distributions, based upon the use of indigoid dyes. Ernster's presentation of his more recent work on the distribution and interaction of enzymes is highlighted by his discussion of the relationship of Krebs' cycle enzymes to mitochondrial structure. "Structure and Function in Microorganisms" by P. Mitchell is mainly concerned with the problems of active and passive transport of metabolites across microbial membranes and is notable for the lucid presentation of the general theories of membrane transport. The symposium concludes with an article by J. D. Judah and K. R. Rees on the changes in cellular components such as Diphosphopyridinenucleotide brought about by carbon tetrachloride injury. The book is well worth a careful study by all those interested in the relationship between cell structure and metabolism.

P. S. SARMA.

Proteins in Foods. By S. Kuppaswamy, M. Srinivasan and V. Subrahmanyam. (Special Report Series, No. 33.) (Indian Council of Medical Research, New Delhi), 1958. Pp. iii + 289. Price Rs. 12-00.

Proteins are important constituents of plant and animal cells. While plants synthesize proteins from simple inorganic elements of the soil, animals have to depend on ready-made proteins and their breakdown products. Dietary surveys in India show that the bulk of the food in Indian dietaries consists of cereals and pulses which supply about 80% of the total energy and are the major source of dietary

proteins. It has been reckoned that 10 to 14% of the calories in the diets of populations in economically advanced countries is contributed by protein. This level of protein calories is not likely to be reached in diets based predominantly on cereals, tubers and pulses which are consumed by large sections of the population in India. A better nutritional status can be achieved by placing before the people all available knowledge on the protein content and the protein quality of various food materials produced in respective localities so that they can intelligently select from among them the best possible balanced diet without incurring much additional cost to the family budget.

The present review on "Protein in Food" gives us information on protein contents of different food-stuffs including their nutritive value and amino-acid composition under each class of food-stuffs and a survey of the entire literature on the subject. Tables are given under each chapter in two sections, one on the nutritive value and the other on the essential amino-acid composition of the proteins in the food-stuffs. This is followed by relevant bibliography. In view of the importance of proteins in nutrition, the information given in this book will be of great value not only to the nutrition chemists and the dietetician but also to the average citizen in order to enable him to plan for his daily dietary in a befitting manner.

C. H. CHAKRABARTI.
M. C. NATH.

Patterns of Discovery—An Inquiry into the Conceptual Foundation of Science. By N. R. Hanson. (Cambridge University Press, London N.W. 1), 1959. Pp. 240. Price 30 sh.

The development of the subject of quantum mechanics has had a profound effect on the philosophical thought of the West in recent years. The new conceptual set-up has been variously discussed not merely by physicists but by professional philosophers as well. In this book, *Patterns of Discovery*, Professor Hanson has chosen to discuss some of the philosophical concepts in the light of the new situation in physics. The book is admittedly terse from the point of view of the physicist unaccustomed to philosophical thought. But the careful and the thorough manner in which it has been written, with examples to drive home difficult ideas, makes one take to it.

In the first chapter has been discussed the concept of 'observation'. 'Seeing' is not merely a physical state, a systematic exposure of the

senses to the world, but is an 'experience' involving organisation of what is seen. Also 'seeing this or that' threads knowledge into our seeing and the vital role played by the 'language' employed in this connection cannot be overemphasised. The next chapter dealing with facts, viz., the object of an experience, reminds us that the commonsense view of the facts as 'being or happening out there' is far from being true. It turns out on scrutiny that 'facts' are not picturable, observable entities, and are perhaps somehow 'moulded' by the logical forms of the fact-stating language, perhaps a mould in terms of which the word 'coagulates' in definite ways. The third chapter deals with 'causality', a much discussed topic in modern physics. The causal chain view has come in for criticism and it has been shown that this enquiry is, "theory-loaded" from the beginning. The so-called effects and causes (of which there are as many as the attempted explanations of the effects) are 'connected' only because our theories connect them and form items in an interlocked pattern of concepts. In the chapter on theories we are reminded that in his search for an explanation of data, the goal of the physicist is a conceptual pattern in terms of which his data will fit intelligibly alongside better known data. The method employed is not the method of deduction (which proves something must be), or the method of induction (which shows that something is actually operative), but the method of retrodution or abduction (*apagoge* of Aristotle) which suggests that something may be. A theory is a cluster of conclusions in search of a premise, a keystone idea from which the data are explicable as a matter of course, and it is built up in 'reverse' retroductively. The classical particle physics and the elementary particle physics, (the basic idea of the latter being "interaction") which occupy the last two chapters are examined against this background.

A careful study of the book would be of help both to the physicist and the professional philosopher. It may be pointed out, however, that many of the ideas advanced here call up to one's mind the profound discussion in Indian philosophy pertaining to topics such as *Pratyaksha* (Perception), *Anubhava* (Experience); *Vishayata* (Objectness), *Karyakarana Bhava* (cause and effect relationship), *Prakriyachana* (building up of theories), *Paramanuvada* (Elementary particle theory), etc. Students of physics and philosophy would do well to remember Heisenberg's¹ observation,

viz. "Many of the abstractions that are characteristic of modern theoretical physics are to be found discussed in the philosophy of past centuries and we are compelled by the refinements of experimental art to consider them seriously" and to take to a study of these topics in the manner of the previous generations and estimate modern physical thought in the light of such studies.

D. S. SUBBARAMAIA.

The Coconut Palm—A Monograph. By K. P. V. Menon & K. M. Pandalai. (Published by the Indian Central Coconut Committee), 1957. Pp. 357. Price Rs. 38-00.

The present publication is the outcome of the commendable programme of the Indian Council of Agricultural Research and its Commodity Committees initiated by Dr. M. S. Randhawa, the Vice-President, to bring out a series of critical monographs on the important crops of India. The publication brings together all information available on various aspects of coconut palm including its morphology, anatomy, cytology, physiology, cultural practices and the control of pests and diseases. With the establishment of Coconut Research Stations several years ago at Kasargod and Kayangulam, India has contributed much to our present knowledge of this valuable tree crop, and the excellent publications of Sampson in 1923 and Patel in 1938 had become out of date. The present monograph has not only utilised the information available in these previous publications, but has also brought up-to-date results obtained since then. Although coconut is an important crop of India, it is also grown extensively in other countries like Ceylon, the Philippines, New Guinea, Trinidad and Jamaica. Considerable work is also being done on scientific aspects of coconut in these countries and the present monograph includes the results obtained also in these countries. It can, therefore, be said that the objective to consolidate all available facts pertaining to the coconut in a single publication has been achieved.

The book itself is divided into 18 Chapters dealing with the different investigations that have been in progress. The first four chapters deal with the palm, its original home and its botany. Chapters four, five and seven deal with what is at present understood as varieties, their classification breeding and production of quality material. The chapter on breeding is, however, brief and could have been dealt in greater detail. Perhaps the controversy that exists about the

1. Physical Principles of the Quantum Theory.

application of regular breeding practices to this tree crop has made the authors rather conservative in their outlook. One may not entirely agree with the views expounded by Dr. Harland with regard to breeding of coconut. A critical examination of the available data, both in India and in some other countries where investigations have been in progress, might perhaps show that selection of mother trees as it is advocated and practised has provided profitable results, and it is learnt that such a study undertaken in Ceylon does seem to indicate that selection of individuals for number of nuts and nut-weights can be effective. There is no doubt, however, that the improvement of this tree plant should be taken up seriously and on proper lines.

Chapter five on climate and soil conditions could well have been dealt in the beginning or at least before discussing varieties and breeding.

Information on cultural practices in the field, soil conditions, plantation management, yield, etc., are discussed in the next five chapters. They are fairly exhaustive and provide information of practical value not only to technicians engaged in scientific investigations, but also to actual coconut growers.

The diseases and soil conditions in relation to health and disease are discussed in the subsequent two chapters. Investigations have emphasized how complicated the disease problem is, and how it has to be attacked from a wide angle including the soil, the physiology of the palm and its nutrition, viruses, nematode, etc. The chapter on pests is, however, much more critical and contains valuable information on the chief insect pests and methods that have been developed for their control.

The next three chapters deal respectively with tapping, abnormalities and utilisation of coconut products. Perhaps the chapter on abnormalities could have been treated next to the botany of the palm. The concluding chapter on certain problems in coconut research discusses the present position of our knowledge and indicates where all lucuma exists needing further studies and investigations.

The book contains a large number of good illustrations and coloured plates which add to the attractiveness of the volume and incidentally also to its cost. The objectives of this publication is to bring together technical information for the benefit of investigators and technologists and the Coconut Committee could not have made it any cheaper. Perhaps a sister volume embodying the main practical principles of coconut growing can be written for the use of actual growers.

The authors have been associated with coconut research for nearly two decades and the treatment of the material available could not have been in better hands. The information available all over the world has been well compiled and the only criticism, if it is a criticism at all, can be that the authors could have been a little more critical in assessing the value of information compiled.

K. R.

Books Received

- Jets and Rockets.* By A. Barker, T. R. F. Nonweiler, R. Smelt, 1959. Pp. xiv + 268. Price 35 sh.; *Metal Fatigue.* Edited by J. A. Pope, 1959. Pp. xiv + 381. Price 70 sh.; *Aircraft Electrical Engineering.* Edited by G. G. Wakefield, 1959. Pp. xiv + 349. Price 50 sh. (Chapman & Hall Ltd., London W.C. 2; India: Asia Publishing House Bombay-1).
- Heterocyclic Chemistry, an Introduction.* By A. Albert. (The Athlone Press, 2, Gower Street, London W.C. 1), 1959. Pp. viii + 424. Price 45 sh.
- Plant Diseases, Their Causes and Control.* 2nd Revised Edition. By S. Chowdhury. (Kitabistan, Allahabad), 1958. Pp. 106. Price Rs. 3-50.
- Blood Groups—British Medical Bulletin*, Vol. 15, No. 2, May, 1959. (The British Council, London W. 1), 1959. Pp. 89-173. Price 20 sh. (Dover Publications, New York-14), 1959.
- Magnetic Sound Recording.* By D. A. Snel. (Philips Tech. Lib., Eindhoven; India: Philips India Ltd., Calcutta-20), 1959. Pp. xii + 217. Price Rs. 12-00.
- The Harvey Lectures*, 1957-58. (Academic Press, New York 3), 1959. Pp. xiv + 254. Price \$ 7.50.
- Methods of Biochemical Analysis*, Vol. 7. Edited by D. Glick. (Interscience Pub., New York-1), 1959. Pp. ix + 353. Price \$ 9.50.
- Electronic Digital Computers.* By C. V. L. Smith (McGraw-Hill Book Co., London E. C. 4), 1959. Pp. ix + 443. Price \$ 12.00.
- Nuclear Magnetic Resonance—Applications to Organic Chemistry.* By John D. Roberts. (McGraw-Hill Book Co., London E.C. 4), 1959. Pp. viii + 118. Price \$ 6.00.
- Principles of Modern Physics.* By Robert B. Leighton. (McGraw-Hill Book Co., London E.C. 4), 1959. Pp. xi + 795. Price \$ 12.50.
- Advanced Calculus.* By Edwin Bidwell Wilson. (Dover Publications, New York-14), 1959. Pp. ix + 566. Price \$ 2.45.

SCIENCE NOTES AND NEWS

Award of Research Degree

The Agra University has awarded the Ph.D. Degree in Chemistry to Shri Vishnu for his thesis entitled "Physico-Chemical Studies on Polycapillary Saccharine System".

The Gujarat University has awarded the Ph.D. Degree to Messrs. T. S. G. Sastry, R. N. Kulkarni and Satya Prakash for their theses entitled "The Time Variation of Cosmic Rays at Low Latitudes", "Studies on Atmospheric Ozone" and "Studies in Cosmic Rays" respectively.

The Karnatak University has awarded the Ph.D. Degree in Physics to Shri K. S. Raghavendra Rao for his thesis entitled "Problems of Molecular Spectra-Studies on Active Nitrogen".

The Utkal University has awarded the D.Sc. Degree in Chemistry to Shri Mahendra Kumar Raut for his thesis entitled "Studies on Heterocyclic Compounds".

Birbal Sahni Institute of Palaeobotany,
Lucknow

The twelfth annual scientific meeting of the Palaeobotanical Society will be held at the Institute's premises on the 22nd and 23rd of January 1960. The programme chalked out includes lectures, reading of papers and discussions. Palaeobotanists from all over India are expected to participate.

Meeting of Commission on Ecology

Commission on Ecology of the International Union for the Conservation of Nature and Natural Resources is arranging a meeting of the Commission at Warsaw from 14th to 29th June 1960. Discussions will be centred on the following three themes: (1) The Impact of Man and Modern Technology on Nature and Natural Resources; (2) Management of Wild Grazing Animals in Temperate Zones and its Relation to Land Use; (3) Ecological Effects of the Biological and Chemical Control of Undesirable Plants and Animals.

Any scientist desirous of presenting paper on any of the above themes may please contact Dr. G. S. Puri, Member of the Commission on Ecology, IUCN, Botanical Survey of India, 7, Koregaon Road, Poona-1, for further information.

Silver Jubilee of the Department of Chemical
Technology, University of Bombay

The Bombay University Department of Chemical Technology has completed 25 years of its useful work and the Silver Jubilee of its foundation will be celebrated in the first week of January 1960. The Department is fully equipped for chemical and technological research, and from the earliest stages of its development research played a very important part. The Department has done pioneering work in the field of Dyestuff Technology. Besides 400 degree students, there are about 125 research workers including candidates for the degrees of M.Sc. (Tech.) and Ph.D. The Department enjoys a number of endowments from individuals, corporations and industrial firms.

To commemorate the occasion a Silver Jubilee Fund is created which will be utilized to improve research facilities and student welfare activities.

UNESCO Symposium on 'ALGOLOGY'

An international symposium on 'ALGOLOGY' will be held at the Indian Agricultural Research Institute, New Delhi, during 7-12 December 1959, under the joint sponsorship of the Indian Council of Agricultural Research and UNESCO. Main Topics which will be discussed are nitrogen fixing algae, edible algae and their mass culture.

UNESCO has invited to the symposium Dr. G. E. Fogg, London, Prof. Dr. Hiroshi Tamiya, Japan and Prof. Dr. H. V. Witsch, Fed. Rep. (Germany). In addition UNESCO has extended invitations to the Governments of Afghanistan, Burma, Ceylon, India, Nepal and Pakistan, to send a participant each. F.A.O. may also send an expert. The symposium will bring together about 120 scientists and 30 papers are scheduled for presentation.

Enquiries about the symposium should be addressed to the UNESCO South Asia Science Co-operation Office, 21, Curzon Road, New Delhi, India.

New Radio Telescope in Australia

Australian research in radio-astronomy will be extended by the construction of the big new radio telescope, which is to be erected at Parkes, New South Wales, at a cost of nearly £ 750,000 (see Curr. Sci., 1957, 26, 371). A contract had

been planned for the construction of the big new radio telescope, which is to be erected at Parkes, New South Wales, at a cost of nearly £ 750,000 (see Curr. Sci., 1957, 26, 371). A contract had been placed with the British firm of J. D. Brown & Co. Ltd. for the construction of the steel structure of the telescope. The firm has now received the contract for the construction of the steel structure of the telescope. The firm has now received the contract for the construction of the steel structure of the telescope.

Atomic
New

The U.S. Atomic Energy Commission has announced that it will open a new facility for the study of atomic energy. The facility will be used for the study of atomic energy and will be open to the public. The facility will be used for the study of atomic energy and will be open to the public.

The two similar September Conference on Energy. There were its nuclear its irradiation element. It is invited by side John J.

Fossil

The fossils, when Lowens reported this

been placed with a German firm for the construction of the telescope. International interest in the project is shown by the financial assistance received from the Rockefeller Foundation and the Carnegie Corporation, and the fact that details of the design were worked out by the British firm of consulting engineers, Messrs. Freeman, Fox and Partners, in collaboration with Dr. E. G. Bowen of the C.S.R.O.

The "mirror" which collects and focusses incoming radio waves will be a bowl-shaped steel structure 210 feet in diameter, and covered with wire-mesh. Although slightly smaller in diameter than the British telescope at Jodrell Bank, the Parkes instrument will embody many improvements which will result in higher precision, smoother movement and a general all-round increase in efficiency.

Atomic Reactor at the Agricultural Fair in New Delhi

The U. S. Atomic Reactor TRIGA (see *Curr. Sci.*, January 1959, p. 11) will be a feature attraction at the First World Agricultural Fair opening in New Delhi, on December 14, 1959. It will give visitors to the Fair an unusual opportunity to see nuclear research in action demonstrating one of the peaceful uses of atomic energy, namely, in the field of agricultural research. There will be spot experiments to demonstrate the use of radio-isotopes, produced by TRIGA, in the improvement of crop strains and yields, in the control of pests of plant and animal diseases.

The TRIGA which will be in operation for the two months of the Fair in New Delhi, is similar to the one which was demonstrated in September 1958, in Geneva, at the International Conference on the Peaceful Uses of Atomic Energy. Besides the operating TRIGA reactor, there will also be a full size cutaway model of its nuclear core providing a close up view of its irradiation facilities and its fuel moderator elements, of uranium-zirconium hydride.

It is stated that Indian scientists will be invited to operate the TRIGA and work side by side with American personnel from the John Jay Hopkins Laboratory.

Fossil Indicator Checked

The ratio of oxygen-18 and oxygen-16 in fossils indicates the temperature of the water when the fossils were laid down. H. A. Lowenstam, California Institute of Technology, reported that he has confirmed the validity of this technique by studying magnesium and

strontium contents of calcium carbonate remains. The identity of results of the three methods suggests that the magnesium and strontium intake of specimens 250 million years old was the same as today's; thus the chemical composition of sea-water has remained unchanged during this time. Lowenstam is now working on specimens 400 million years old.—*ISLO Newsletter*.

Astronomical Gamma Rays

From radio telescope studies it is known that two particularly large sources of radiant energy are the Crab nebula and the stellar object called Cygnus A. The Crab nebula is probably the remains of a supernova explosion while the source in Cygnus may be a large-scale collision between matter and anti-matter. On the basis of these two hypotheses, M. P. Savedoff (*Nuovo Cimento*, Vol 13, p. 12) has calculated the flux of γ -rays that might be expected from them at the Earth's surface. He concludes that the Crab—assuming that the radiation would come from the radioactive decay of Californium—might provide seven γ -rays per sq. cm., per hundred thousand (10^5) seconds (about 28 hours) and that four γ -rays/cm.²/10⁵ sec. should be received from Cygnus, from the decay of the meson. Since it has been estimated that suitable stacks of oriented nuclear emulsion film might discriminate a flux of five γ -rays/cm.²/10⁵ sec., Savedoff believes that experiments with such stacks might be able to test the truth of the two hypotheses.

Transistors for Hot Zones

A novel method has been devised to obtain single crystals of very pure silicon carbide. Transistors made from such crystals promise to work at very much higher temperatures than do those currently in use which employ germanium or silicon as the semiconducting element: 1,800° F., compared with Circa 200° to 450° F.

The method involves melting pure silicon in a carbon crucible. In due course the carbon diffuses into, and saturates, the solution. Careful temperature control is exercised to introduce a cool region in the solution where a single crystal of silicon carbide can then be grown.

Semiconductor materials prepared by this method should prove useful in applications where the environment is hot or where there is a problem of heat dissipation such as may occur in complex electronic equipment embodying very small components.—*ISLO Newsletter*.

How Vitamin B₁₂ Works

Dr. A. Sreenivasan *et al.*, of the Department of Chemical Technology, Bombay, report new work on protection of the body by Vitamin B₁₂ in particular in cases of over-active thyroid and liver poisoning (*Biochemical Journal*, Vol. 72, pp. 374 and 384).

They have examined how B₁₂ reserves in the tissues help to repair the damage done to the mitochondria, the small bodies in living cells active in respiration processes. Their work suggests that B₁₂ influences the level of compounds containing a sulphur-hydrogen group, for instance glutathione. They therefore suppose that it is this control by B₁₂ which in turn keeps the mitochondria in good metabolic condition.

Support for this view comes from their work on rats, in which they caused liver damage by administering carbon tetrachloride. The livers were depleted of glutathione, ribonucleoprotein and phosphorous compounds, while fat accumulated. Vitamin B₁₂ afforded protection against these conditions by its effect upon the mitochondria.

Alloying Steel with Tellurium

In recent years tellurium has been used as an alloying element in cast iron, where it prevents chilling, and in view of its great effectiveness investigations have been carried out to study its effect on steel. A structural steel with 0.4% carbon content (0.18% silicon and 0.7% manganese) was produced and alloyed with varying amounts of tellurium—from 0.06% to 1%. The resulting specimens were then subjected to various tests such as static strength, impact strength, hardenability and grain growth.

When the non-alloyed steel was heated to 1,200° C. and slowly cooled down, its impact strength dropped to less than half of the usual value. An addition of only 0.014% tellurium was sufficient to maintain the full impact strength. It was also found that tellurium greatly retards grain growth in heating up to 1,150° C. Another effect is a considerably reduced hardenability. With a tellurium content above 0.015% the static properties of the steel were somewhat lowered, but this could be countered by introducing 0.1% cerium. In this

manner a structural steel containing a small amount of tellurium (and preferably also cerium) becomes less susceptible to the effect of overheating and hardens to a smaller depth than an unalloyed one, and can be safely used for induction-hardened components, which at present have to be made from carburised steels.

Electromagnetic Detector for Locating Ore Deposits

A new type of airborne electromagnetic apparatus working on the principle of the wartime mine detector is expected to afford greater sensitivity in searches for mineral deposits.

The principal components of the detector are a transmitter, a receiver and a recorder. The aeroplane has a pod on each wingtip. The transmitter produces an alternating magnetic field in a tuned coil in the starboard pod. This induces a voltage in a second coil housed in the port pod connected to the receiver.

When the aircraft is flying beyond the range of ground influences, the induced voltage in the receiving coil is balanced by a current of equal magnitude but opposite phase derived from a secondary winding on the transmitting coil. If the unit passes over a big conducting ore-body, however, eddy currents are induced in the body and these alter the magnetic field in the receiving coil, producing an unbalance signal. By amplifying and resolving this signal, the system can be made to distinguish between zones of conducting minerals and areas of poor conductivity like swamps and saline overburden.

Although the idea of locating ores by electromagnetic methods is not new, it has not always been easy to discriminate between swamps and potentially valuable sites such as deposits of metallic sulphides. The new system is thought to be superior in some ways to earlier detectors using two frequencies and recording only the in-phase component. Now a single frequency is employed and both in-phase and out-of-phase components are measured so that a varying phase shift is obtained, according to the conductivity of the ore-body. Since the coils are mounted on the wingtips, the signal does not wander as has been known to happen when the coil is fixed to a drogue towed behind the aircraft.—*ISLO Newsletter*.

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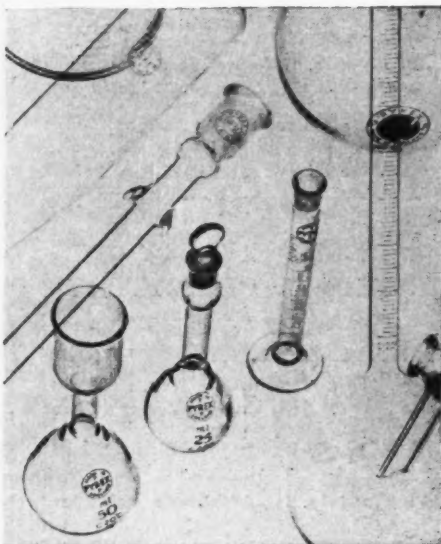
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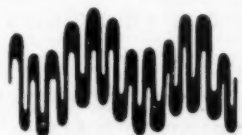
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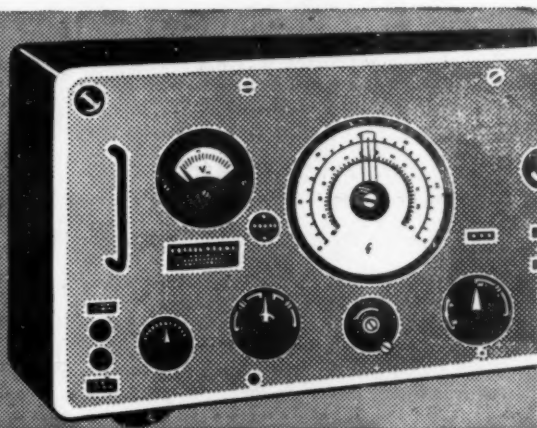
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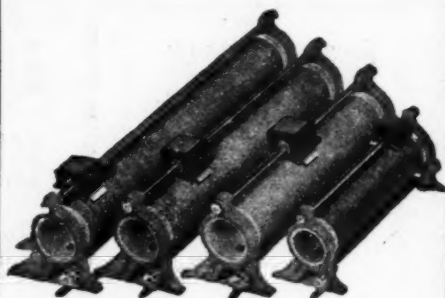
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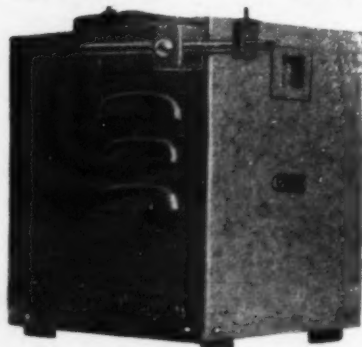
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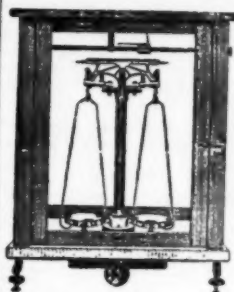
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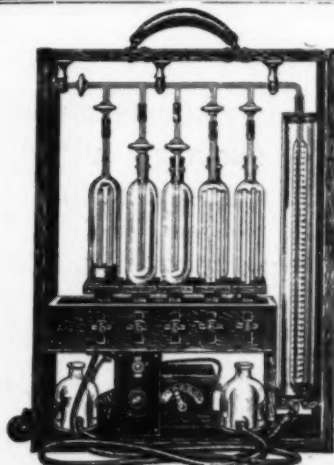


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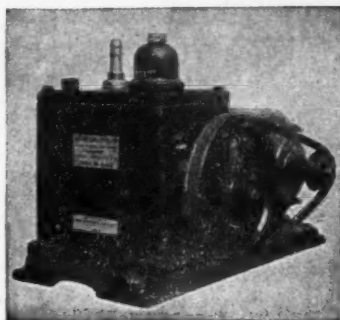
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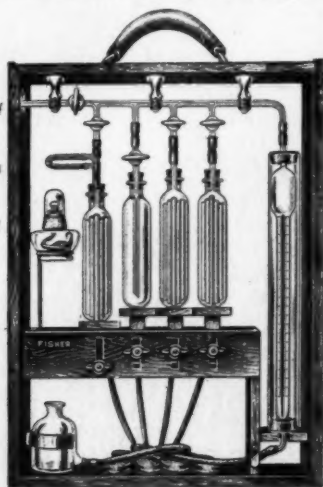
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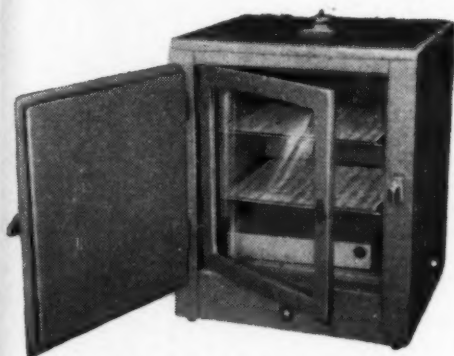
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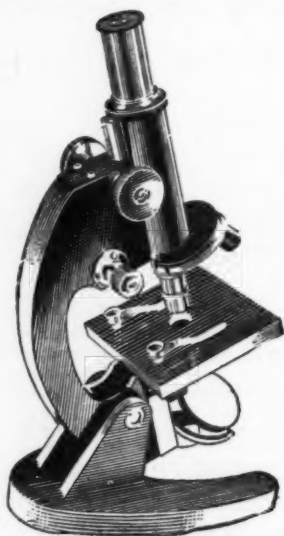
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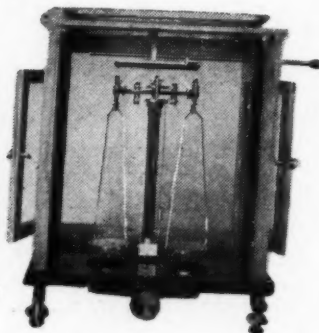
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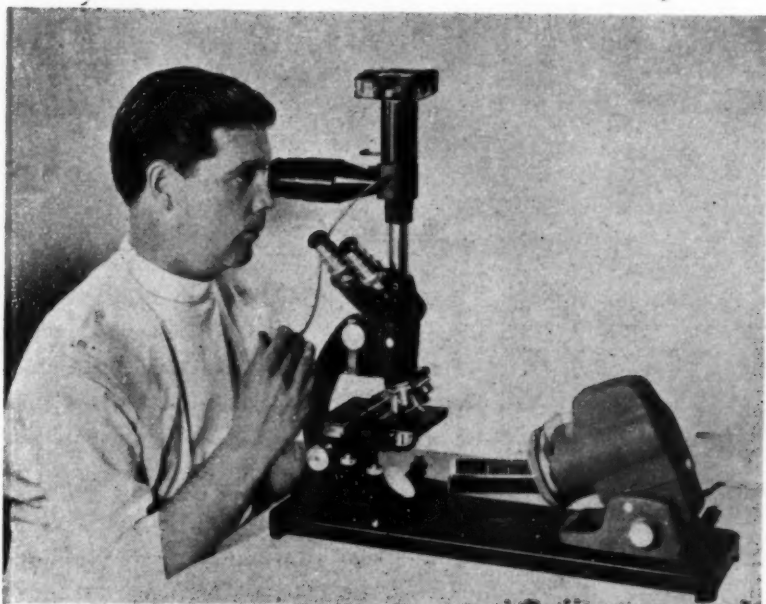
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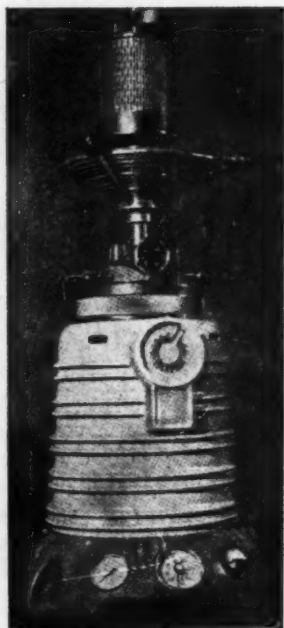
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